



Mine Resistant Ambush-Protected (MRAP) Vehicles



What are MRAPs?

MRAPs are Mine Resistant Ambush-Protected vehicles. MRAPs provide significant protection from small arms and are especially adept at mitigating blast effects. Most MRAPs also have the ability to carry extra protection for other types of specialized threats as the mission dictates. All variants of MRAPs come complete with a communications suite, a gunner's turret, and a chassis capable of much higher mobility than other vehicles of similar weight. The need for them became apparent in Iraq after mounted units realized that Humvees and Strykers were not sufficient to protect troops against mines and improvised explosive devices (IEDs).

MRAPs were developed as a program under the U.S. Army's Program Executive Office for Combat Support and Combat Service Support. The MRAP program was well-funded and was a Joint Urgent Operational Needs "rush" program to deliver vehicles to the combat theaters in Iraq and Afghanistan for all military services. The program was under pressure to meet the competing needs of various threats and to field different MRAP variants specific to each theater and user-particular mission. MRAPs may be categorized as Utility Vehicles, Rapid Response Vehicles, Mobile All-Terrain, or Special Purposes (such as Recovery Vehicles or Ambulances).

There are three general categories (I, II, and III) of MRAPs based on the weight and size (and number of axles) of the vehicles. Because of the many variants (over 50 currently) it is sometimes difficult to distinguish categories, variants, and even manufacturers. The MRAP-All Terrain Vehicle (M-ATV) is also a category of MRAP. Different models and variants in each category are represented in figures 1-4.

Figure 1: Category I MRAP Vehicles



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Figure 2: Category II MRAP Vehicles



How many MRAPs are there?

In fiscal year 2010 the MRAP program was the Department of Defense's (DoD) largest dollar program. There were approximately 28,000 MRAP vehicles produced in less than 3 years, with production, testing, and fielding occurring simultaneously. During this period over 24,000 MRAPs were fielded in Iraq and Afghanistan.

As this program progressed the result was over 90 contracts being let, 6 original equipment manufacturers, and over 50 variants of MRAP vehicles.

What is the problem with MRAPs returning to CONUS?

As the conflicts in the Middle East draw down those existing fielded MRAPs are being returned to continental United States (CONUS). Some of these vehicles will go into storage while others will be used at stateside installations for training. Some MRAPs will be divested to other Federal agencies such as the Department of Homeland Security or the Federal Bureau of Investigation. Some MRAPs are being destroyed, given, or sold to other countries.

Operational safety problems have been identified with the MRAPs, primarily due to their size, weight, and poor visibility. (see page 6, MRAP Use on Installations)

MRAPs cannot be operated on public roads off of installations, and if hauled by Heavy Equipment Transporters (HET) or other trucks they will need to comply with Federal and State requirements (see page 6, Existing Guidance on MRAP Operation, and Regulations).

The types of commonly-used MRAPs is being reduced to 23 variants—allowing the DoD to operate and maintain fewer systems.

Figure 3: Category III MRAP Vehicle (Buffalo is shown)



Figure 4: M-ATV MRAP Vehicle



“End state” of MRAPs

The MRAP lessons-learned are also being passed on to other vehicles (as with the Double V-Hull on Strykers), and an evolutionary process continues to develop better MRAPs or other programs such as the Medium Mine Protected Vehicle, or Joint Light Tactical Vehicle.

As the MRAPs are slowly returned from theater and offered to other services and agencies there is a requirement to consider the transportation needs and problems these large vehicles present. To assist in this, the SDDCTEA Programmatic Division prepares “Transportability Approval” documents for all types of vehicles. These documents usually contain an attachment for “Internal Air Transport Certification” prepared by the Air Force Materiel Command (at Wright-Patterson AFB) as well as the requirements and tiedown procedures for transport on railcars, sealift, tractor trailer highway loads, and self-propelled over-the-road transportability. SDDCTEA Deployability Branch derives this data from physical testing that occurs on the vehicle at Aberdeen Proving Ground, Maryland or Yuma Proving Ground, Arizona. This testing includes a physical pull test of the vehicle’s tiedown provisions, a lift test (to ensure that the item can be lifted), and a rail impact test as required by the Association of American Railroads. SDDCTEA’s approval often refers to that shown in figure 6 on page 4, of Unrestricted (without Permits) Highway Limits (in inches and pounds).

Military Load Classification (MLC)

This is discussed in U.S. Army Field Manual 3-34. 170/ MCWP 3-17.4, *Engineer Reconnaissance*; and can be found in the online Central Army Registry, <https://rdl.train.army.mil>.

A route’s MLC is a class number representing the safe load-carrying capacity and indicating the maximum vehicle class that can be accepted under normal conditions. Usually, the lowest bridge MLC (regardless of the vehicle type or conditions of traffic flow) determines the route’s MLC. A bridge’s posted MLC is shown in the photo on page 4. If there is not a bridge on the route, the worst section of road will determine the route’s overall classification (see the website link above for a further discussion of MLC).

In cases where vehicles have a higher MLC than the route, an alternate route may be sought or an additional reconnaissance of the roads within the route may be necessary to determine whether a change in traffic

flow (such as single-flow crossing of a weak point) will permit heavier vehicles on the route. When possible, ensure that the route network includes a number of heavy-traffic roads, as well as average traffic roads. This helps staff planners manage heavy-traffic loads to decrease the bottleneck effect.

The entire network’s class is determined by the minimum load classification of a road or a bridge within the network. The broad categories are:

- ✓ Class 50 - average-traffic route.
- ✓ Class 80 - heavy-traffic route.
- ✓ Class 120 - very heavy-traffic route.

Figure 5 on page 4 shows common vehicles with MLCs.

Weight and Length Standards

Vehicles within these limits generally do not require coordination with the installation’s transportation officer for further approval from the host State for driving on State routes. MRAPs will usually exceed the weight, height, or width limits.

To preserve our Nation’s infrastructure and to keep trucks and buses moving efficiently, States must ensure that commercial motor vehicles comply with federal size and weight standards. The Federal Highway Administration (FHWA) is responsible for certifying State compliance with Federal standards. The National Vehicle Size and Weight Team is a part of the FHWA’s Office of Freight Management and Operations, and it oversees State enforcement of heavy truck and bus size and weight standards in the United States. The Vehicle Size and Weight Team is assisted by FHWA’s policy and legal staff.

National weight standards apply to commercial vehicle operations on the Interstate Highway System. Off the Interstate Highway System, states may set their own commercial vehicle weight standards.

Federal commercial vehicle maximum standards on the Interstate Highway System are:

- ✓ Single Rear Axle: 20,000 pounds
- ✓ Tandem Rear Axle: 34,000 pounds
- ✓ Maximum Gross Vehicle Weight: 80,000 pounds

Figure 6 shows unrestricted highway limits for vehicles. In addition to the maximum weight standards, FHWA has standards for commercial vehicle size limits on the National Network, as shown in figure 7 on page 5.

Figure 5: Reference List of Common Vehicles with MLCs



Nomenclature	Name	Description	MLC Empty	MLC Loaded
AAV	<i>Amphibious assault vehicle</i>		<i>(use 26.5 tons)</i>	
Abrams	<i>Towing explosive standoff minefield breacher (ESMB) trailer</i>	<i>Tracked, combination: vehicle</i>		<i>75 (estimated)</i>
AGS	<i>Armored gun system</i>		<i>(use 24.75 tons)</i>	
ASWDS	<i>Airborne scraper</i>	<i>Wheeled: truck, 2-axle</i>	19	
C7	<i>Loader, scoop 2.5 cubic yards without roll cage</i>			20
Caiman	<i>Mine resistant ambush protected (MRAP) - Cat I</i>	<i>Wheeled: truck, 2-axle</i>		15
Caiman	<i>MRAP - Cat II</i>	<i>Wheeled: truck, 3-axle</i>		19

Figure 6: Unrestricted Highway Limits

	Length (inches)	Combination Length (inches)	Width (inches)	Height (inches)	Single Axle Load (lbs)	Tandem Axle Load (lbs)
CONUS	480.0	660.0	96.0	162.0	20,000	34,000
NATO Countries	393.7	551.2	98.4	149.6	17,637	24,251
Korea	657.5		98.4	157.5	22,046	44,092

Figure 7: Federal Commercial Vehicle Size Limits on the National Network

Overall vehicle length	No federal length limit is imposed on most truck tractor-semitrailers operation on the National Network. Exception: On the National Network, combination vehicles (truck tractor plus semitrailer or trailer) designed and used specifically to carry automobiles or boats in specially designed racks may not exceed a maximum overall vehicle length of 65 feet, or 75 feet, depending on the type of connection between the tractor and trailer.
Trailer length	Federal law provides that no State may impose a length limitation of less than 48 feet (or longer if provided for by grandfather rights) on a semitrailer operating in any truck tractor-semitrailer combination on the National Network. (Note: A State may permit longer trailers to operate on its National Network highways.)
Vehicle width	On the National Network, no State may impose a width limitation of more or less than 102 inches. (Safety devices such as mirrors and handholds necessary for the safe and efficient operation of motor vehicles may not be included in the calculation of width.)
Vehicle height	No federal vehicle height limit is imposed. State standards range from 13.6 feet to 14.6 feet.

Source: U.S. Department of Transportation, Federal Highway Administration. *Federal Site Regulations for Commercial Motor Vehicles*. Washington, DC, 1996.

Oversize or Overweight Permits

The Federal government does not issue permits for oversize or overweight vehicles because this is the State's option. When considering the need for a permit, the load can be classified as either a divisible or a nondivisible load. Nondivisible loads cannot be easily separated into smaller loads or multiple vehicles, and States may issue permits to such vehicles without regard to the axle, gross weight, or Federal "bridge formula" requirements. The bridge formula is established by Federal law and is used to determine the appropriate maximum gross weight for a commercial motor vehicle on the Interstate Highway System based on the number of axles and the distance between axles.

When an oversize load is transported, any of the following may be required as part of the permit: Oversize load banners on front and rear of vehicle, a leading escort vehicle with oversize load banners, a following escort vehicle with oversize load banners, and possibly a police escort.

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Regulations

Defense Travel Regulation Part III: "Certification by a military authority that the oversize or overweight vehicle and/or cargo is essential, cannot be reduced in size or weight, and cannot be moved by another mode of transportation to meet the required delivery date. This certification is a means to inform regulatory authorities of the importance of the movement and allow maximum flexibility in approving a permit."

MRAP Use on Installations

Bringing MRAP vehicles home to operate on roads that are not designed for large, oversized vehicles presents many problems for home stationing. MRAPs are wider than most vehicles, which could contribute to sideswipe crashes. MRAPs are also higher, which makes it harder for the driver to see over the hood and vehicle edges. Additionally, the driver's field of view is very limited due to small thick windows so other vehicles, pedestrians, and obstacles might be obscured.

MRAP bumpers are higher than normal vehicles. For operation on roads within a state, each state may have statutes that specify the permitted bumper height, or whether modifications of the original manufactured bumper height are permitted. The National Highway Traffic Safety Administration is aware that there is a mismatch between the bumpers of passenger cars and those of some light trucks and vans, and further research is being done on this.

Because MRAPs ride high and have a high center of gravity, the vehicles are also susceptible to rollover.

MRAPs are generally also heavier than standard passenger vehicles. This may in turn lead to damage to roads and bridges. Excessive use on roadway shoulders may cause ruts which may lead to an MRAP sinking into the ground surface or overturn.

Existing Guidance on MRAP Operation

There are several various memorandums, safety of use statements, and information papers regarding MRAP operation and safety concerns, as follows:

- a. **22 Mar 11 Information Paper from the JPO MRAP:** "At this time MRAP vehicles do not have the approval for use on public roads in the United States. Units will have to coordinate with State and local officials for public road access."
- b. **27 Feb 12 Memo from HQ US Army Forces Command:** "The MRAP is not authorized for operation on public roads or off installation."
- c. **22 Feb 13 Memo from the Army Evaluation Center discusses safety limitations and precautions that apply to all MRAP vehicles:**
 - 1) Drivers must have training
 - 2) Don't operate in excess of max GVWR
 - 3) Speed limits (see memo)
 - 4) Approval from local Transportation Officer for operation on public roads (if permitted)
 - 5) Other clearance and environmental limitations and precautions.
- d. **02 May 13 Information Paper from JPO MRAP:** "The Transportability of MRAP Vehicles over CONUS Highways (UPDATE)." This info paper repeats that "The MRAP vehicles subject to this UMR are to be used by FORSCOM in conducting HST and Pre-Deployment Training. This UMR does not address the use of the vehicles on public streets. Appropriate permits must be obtained by the gaining command for vehicle operation outside FORSCOM facilities. Per MIL-STD-1366, MRAP vehicles do not meet all standards for operation on State or Local roads. At this time, the MRAP vehicles do not have approval for use on public roads in the United States. Units will need to coordinate with State and local officials for public road access. " [Note that they are allowed to be transported on trailers].

Supporting Facts [in this Info Paper from JPO]:
 - a) State and Local laws restrict the size and weight of vehicles that can operate on roads without a permit. A vehicle may operate unrestricted on public roadways if it is not oversized and/or overweight.
 - b) The MRAP FoV do not meet the requirements for general unrestricted CONUS transport, as defined in MIL-STD-1366, 5.1 Highway Transportation. Specifically, the vehicles exceed width dimensions, and single axle load limits.
 - c) The MRAP FoV do not fully comply with the Federal Motor Vehicle Safety Standards (FMVSS), which are necessary for unrestricted movement.
 - d) The MRAP FoV may not meet the requirements of the bridge gross weight formula, necessary to avoid overstressing bridges, as defined in MIL-STD-1366, 5.1.2.2 US Federal Bridge Gross Weight Formula.

e) Further guidance can be found in the Transportability Approval for each specific MRAP variant, issued by the Surface Deployment and Distribution Command, Transportation Engineering Agency (SDDCTEA).

Recommendation [in this Info Paper from JPO]:

- a) For highway movements, coordinate with the Installation Transportation Officer (ITO) to obtain the required State permits and Standard Operating Procedure (SOP).
- b) The MRAP FoV may be transported by trailer with permits granted from the appropriate State(s) Department of Transportation, again coordinated through the ITO.

e. **06 Sep 13 Safety of Use Memo from TACOM:**

This memo concerns the operation of MRAPs, Route Clearance, and Assured Mobility Systems Family of Vehicles on public roads off post, and it warns of the severely-limited field of view that can cause accidents and fatalities. It states: "All CONUS and OCONUS Home Station Training (HST) and Pre-Deployment units shall transport MRAP, RC, and AMS vehicles by trailer with permits granted from the appropriate state(s) Department of Transportation when transporting on public roads and highways . . . [and] when operating on mixed traffic roadways on the installation, users shall utilize convoy operations IAW Installation Standard Operating Procedures (SOP) and also coordinate with the Installation Transportation Officer (ITO) to obtain all local, state, and federal Department of Transportation (DOT) road permits." (This is a 3-1/2 page safety memo.)

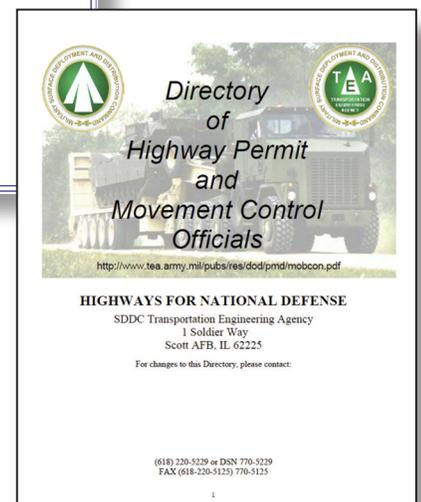
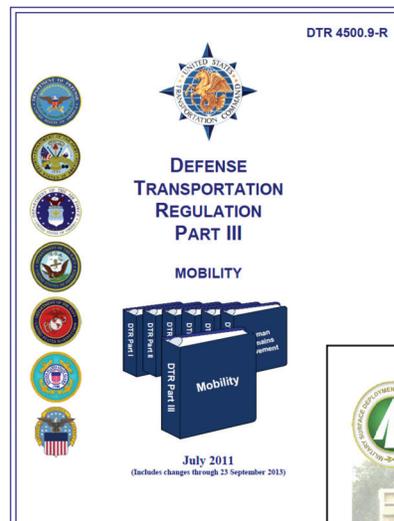
Advice for MRAP Operation

SDDCTEA offers this specific advice for MRAP operation:

- a. Coordinate with Installation and Unit Transportation Officers, and through them with the host State to obtain permission for any off-installation operation. Consult the Defense Transportation Regulation - Part III, Appendix F: This appendix sets forth procedures and administrative requirements for the safe and efficient movement of oversize and/or overweight military vehicles and other special military movements to include convoys on public highways in the CONUS, for obtaining Convoy Movement Orders (CMO) and securing civil permits for oversize/overweight vehicles, and for other special movements and procedures for obtaining logistical support for all movements.

SDDCTEA, Highways for National Defense maintains a directory of DoD officials, Army Mobilization Movement Control (MOBCON) coordinators, and State officials who are authorized to arrange for highway permits for oversize, overweight, and other special military movements on public highways.

- b. Follow guidance and advice from DoD Memorandums, Safety of Use Statements, and Information papers referenced above.
- c. If necessary, obtain Transportability Approvals from SDDCTEA Programmatic Division, Transportability Branch (usarmy.scott.sddc.mbx.tea-dpe@mail.mil).
- d. If necessary, use a HET such as the M1070 tractor and M1000 trailer.
- e. If necessary, operate in convoys. Again, see the Defense Transportation Regulation - Part III, Appendix F for specific procedures. An Army-specific regulation by U.S. Army Forces Command is Regulation 55-1, Transportation and Travel, Unit Movement Planning. The Marine Corps has MCRP 4-11.3F, Convoy Operations Handbook, and 4-11.3G, Unit Embarkation Handbook.





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OFFICIAL BUSINESS

Reference List

- ✓ Joint Program Office MRAP
- ✓ <https://safety.army.mil/drivertrainingtoolbox/mrap.aspx>
- ✓ http://www.ops.fhwa.dot.gov/freight/sw/permit_report/index.htm
- ✓ <http://www.ops.fhwa.dot.gov/freight/sw/index.htm>
- ✓ <http://www.fhwa.dot.gov/policy/otps/truck/index.htm>
- ✓ <http://www.ops.fhwa.dot.gov/freight/sw/map21tswstudy/index.htm>
- ✓ U.S. Department of Transportation, Federal Highway Administration. Federal Site Regulations for Commercial Motor Vehicles. Washington, DC, 1996.

Continuing Education	Phone	Web Site
Pennsylvania State University; The Pennsylvania Transportation Institute	(814) 865-4700	www.pti.psu.edu
University of Maryland; MD Transportation Technology Transfer Center	(301) 403-4623	www.ence.umd.edu/ttc
Georgia Institute of Technology	(404) 385-3501	www.gatech.edu
Northwestern University Center for Public Safety	(800) 323-4011	www.northwestern.edu/nucps/index.htm
Texas A&M University	(979) 845-3211	www.tamu.edu
University of Washington; College of Engineering	(206) 543-2100	www.engr.washington.edu/epp