

**ANNEX H**

**OPERATIONAL TERRAIN**

**TO**

**PURCHASE DESCRIPTION**

**FOR**

**JOINT LIGHT TACTICAL VEHICLE**

**VERSION 3.0.1**

**13<sup>TH</sup> FEBRUARY 2012**

## Revision History

Revision	Date	Description
3.0	20 <sup>th</sup> January 2012	RFP Release.
3.0.1	13 <sup>th</sup> February 2012	No requirement changes. Revision history truncated to start at v3.0. Date and version number changed to match rest of the PD.

## **1 SCOPE**

Annex H defines the JLV operational terrain in terms of terrain category mileage, average speed, and terrain roughness. Military Operations in Urban Terrain (MOUT) discrete events are also described.

## **2 APPLICABLE DOCUMENTS**

There are no Applicable Documents specific to Annex H.

### 3 JLTV OPERATIONAL TERRAIN

The JLTV operational terrain is classified into two (2) overall categories: improved surfaces and unimproved surfaces. Improved surfaces are primary and secondary road ways with some type of all weather surfaces, man-made improvements, and subject to periodic maintenance. Improved surfaces range from paved, high speed roads in excellent condition through rutted and potholed gravel roads as well as a variety of obstacles that can be encountered in MOUT. Unimproved surfaces are trails and cross-country “natural” surfaces with no manmade improvements, no maintenance, and subject to variances of weather. Unimproved terrains include, but are not limited to, deserts, grasslands, sand, swamps, forests, tropical jungles, mountains, shallow rivers, and salt water beaches. The JLTV operational envelope requires the capability for extended, effective operation on all terrain surfaces, but particularly on unimproved surfaces, during all weather conditions both day and night with limited and poor visibility. Table 1 details the average speed, terrain values and improved and unimproved surface mileage for a typical 250 mi (400 km) JLTV mission.

Table 1 - Terrain Values

Terrain values							
Terrain			Average Speed	Wave Number Spectrum	RMS Roughness (Inches)	%	Distance Miles
Improved Surfaces	Primary Surfaces	High Quality Paved Road	55 mph	$G_{xx}(n)=1.4 \times 10^{-8}(n)^{-2.5}$	0.1	10%	25
		Secondary Pavement	50 mph	$G_{xx}(n)=1.9 \times 10^{-7}(n)^{-2.5}$	0.2	10%	25
	Secondary Surfaces	Rough pavement Degraded	40 mph	$G_{xx}(n)=8.0 \times 10^{-7}(n)^{-2.5}$	0.3 – 0.5	10%	25
		MOUT *	N/A	WNS Does Not Apply	N/A	N/A	0
		Loose Surface	35 mph	$G_{xx}(n)=3.0 \times 10^{-5}(n)^{-2.0}$	0.6	18%	45
		Belgian Block	20 mph	$G_{xx}(n)=4.0 \times 10^{-6}(n)^{-1.4}$	0.3 – 0.6	2%	5
		Washboard & Potholes	30 mph	$G_{xx}(n)=4.0 \times 10^{-6}(n)^{-2.4}$	0.7 -1.2	10%	25
Un-Improved Surfaces	Trails		25 mph	$G_{xx}(n)=4.6 \times 10^{-4}(n)^{-1.9}$	1.0 -3.4	20%	50
	Cross-Country		15 mph	$G_{xx}(n)=9.2 \times 10^{-4}(n)^{-2.1}$	1.5 – 4.8	20%	50
						Total	250

\* Table 2 - MOUT Discrete Description

## 3.1 Improved Surfaces

### 3.1.1 Primary Surfaces

Primary surfaces are high quality paved, and secondary pavement with RMS values varying between 0.1 in (0.25 cm) to 0.2 in (0.5 cm). They consist of two (2) or more lanes, all weather, maintained hard surface (paved) roads with good driving visibility designed for heavy, high density traffic. These roads have lanes with a minimum width of 9 ft (2.75 m), road crown to two (2) degrees and all bridges will support the JLTV maximum GVW/GCVW. Secondary pavement can include significantly degraded (potholes, alligator cracking, freeze/thaw breakup) concrete, macadam concrete or asphalt pavements. Forces in third world countries will find there is no prevalence of paved surfaces and the paved surface that exist are of substandard quality. Secondary pavement is more typical of third world primary roads.

### 3.1.2 Secondary Surfaces

Secondary surfaces are primary roads with rough pavement, loose surface, loose surface with washboard and potholes, and Belgian block surfaces with RMS values varying between 0.3 in (0.8 cm) to 1.2 in (3 cm). Third world countries will have large networks of neglected secondary pavement and roads using gravel or similar material as wear surfaces.

Rough pavement is two (2) lane roads with degraded shoulders, and marginal subgrades which produce long wavelength swells and additional degradation of the surface. Grades can vary from 0% up through 6%. Generally, washboard occurs in drier operational areas, whereas pothole gravel roads occur in wet operational areas. These roads are one or more lanes, all weather, occasionally maintained with varying surfaces (large rock, crushed rock, or gravel) intended for medium-weight, low-density traffic. Bridges on secondary or unimproved roads are typically unreliable in terms of their load bearing capacity, meaning that military traffic must reinforce them, cross with caution, or use available alternative crossing methods, such as fording. Grades can vary from 0% up through 15%.

MOU combines extensive manmade structures with characteristics of the terrain types described above, but essentially characterized as a mix of improved surfaces and a variety of discrete obstacles. However, as conflicts within built-up areas escalate, collapsed buildings and other damaged structures produce rubble that increases terrain roughness. Sight distance is severely limited and intersections require blind 90 degree turns to narrow streets. Buildings or walls lining streets create channelized pathways which make rubble piles, vehicle carcasses, bomb craters, or defender created obstructions effective barriers requiring a capability to go over rather than around them. There is limited room for vehicle maneuvering to go around obstacles or avoid kill zones due to narrow streets and alleys. Damaged water systems can flood streets to create wet pavement, weaken pavement substructures, destroyed substandard pavement, rut unpaved roads, and produce mud. Relatively good pavement will deteriorate as it is subjected to repeated military combat and tactical wheeled vehicle traffic. The discrete descriptions of the MOU terrain are detailed in Table 2.

Table 2 - MOUT Discrete Descriptions

MOUT Terrain Discrete Event Description		
Discrete events	Description	Average Speed
Street curbs and obstacles	Obstacle avoidance over a six inch curb parallel to the path of the vehicle (over and back)	15
City debris	Climb over 2 ft high rubble pile	5
City obstacles	Negotiate randomly spaced fixed obstacles	10
Torsional Event	Drive across 12 in deep pot hole and 6 to 8 in half rounds	10
Ditch Slope/River Bank	Drive through V Ditch (45 degree approach angle)	5
Climb multiple vertical steps	Climb and descend 20 feet of 6 inch stairs	5

The MOUT cycle occurs, on average, once every other mission

## 3.2 Unimproved Surfaces

### 3.2.1 Trails

Trails are one lane, unimproved, seldom maintained loose surface roads intended for low density traffic with RMS values varying between 1.0 in (2.5 cm) and 3.4 in (8.6 cm). Typically trails have no defined road width, large obstacles (rubble, boulder, logs, and stumps), cross ditches, washouts, steep slopes, and no bridging/culverts. Naturally occurring grades can vary from 0% up through 40%.

### 3.2.2 Cross Country

Cross country is terrain not subject to repeated traffic with RMS values varying between 1.5 in (3.8 cm) and 4.8 in (12 cm). Cross-country terrain can consist of tank trails with crushed rock or having large exposed obstacles (rocks, boulders), but there are no roads, routes, well-worn trails, or man-made improvements. This includes, but is not limited to, flat desert, marshes, vegetated plains, jungle, dense forest, mountains, and urban rubble. Naturally occurring grades can vary from 0% up through 60%.