

When conducting haul road analysis to optimize dust management and maximize mine operations for productivity and safety, the first step involves the development of proper benchmarks. With the Vericom VC4000 MSI, a standard passenger mining vehicle, larger mine haul equipment, and a water truck; an operational friction matrix is created for any mine regardless of surface.

Once the benchmark is developed, the specific watering methods and haul road **safe/danger/fail** criteria can be created for the specific mine operation. This haul road friction and watering criteria can be used to:

1. Develop a deceleration/friction map for the defined haul roads. This is then used for analysis and comparison with standard watering and dust suppression rates. The objective is to identify haul roads of specific concern and define a standardized process for water flow rates and water truck speeds. Ultimately this is used for each watering event to ensure proper dust management while maximizing productivity. This is also useful for rain events to determine when the mine operation can be safely reopened.
2. Define a haul road deceleration/friction measurement method that is used for an ongoing risk management model for the mine haul road network.
3. As direction and guidance for haul road design, watering, and maintenance practices at future sites.

This benchmark analysis is also use for:

- *Mining operations decisions following a rain event at the mine.*
- *Proactive surface analysis before and after a mine road sheeting event.*
- *Maintain consistent surface behavior to ensure mining operators avoid uncontrolled movements that cause accidents.*
- *Ensure the available road friction is at the optimal condition for maximized haul productivity.*

Process Outline (for watering and rain events)

Assemble the needed equipment and vehicles for the benchmark testing – haul trucks, watering truck, and passenger type light vehicle used in mining operations.

- Start with a dry road. Test the haul truck and light vehicle for friction/deceleration. Do this 3-5 times for each vehicle on the same road. The brake test should be conducted at a safe speed – typically ~20 to 30KPH (~15 to 20 MPH).
- Record the data from each test.
- Watering: Test the water truck and water system to ensure consistent watering and consistent flow rate from the watering system. (minimize overlapping spray, ensure even coverage, and consistent flow rate to manage watering per sq meter based on watering truck speed) It is important to understand that watering truck speeds have a dramatic impact on the water coverage.
- Verify and document the watering application rate, spray coverage, and watering truck speed to determine the proper speed for proper wetting/dust-management.
- With the watering truck defined, begin with a low level of water application. A suggested low watering level could be ~300 ml/m². Test at each water level in increments consistent with your mine operation (perhaps 300, 600, 900, 1200 or 400, 800, 1200).

- If a moisture meter is available, conduct moisture testing at each water event to document more detailed watering information.
- Once testing is completed – compare the dry test data with the various water rates. Large haul trucks tend to have deceleration/stopping rates of 50% to 65% of the passenger vehicle depending on watering level. On a dry surface, a larger mine haul truck typically achieves deceleration of -0.50Gx or more.
- Risk/Danger operation is common for a light vehicle at -0.4 Gx with haul equipment at -0.25 to -0.35 Gx. The operation levels must be set for each mining operation based on road geometry, haul truck speeds, and general safety regulations.
- It is important to note that consistent deceleration/friction data across the mine haul roads is important to avoid ‘operator surprise’ with different conditions. When conditions are variable, haul truck operators can be ‘surprised’ by the change which increases the risk of haul truck operator error.

Dry Road

Haul Road Identifier Haul Road 1 North East / 10 Degree Slope

Friction/Deceleration	Test 1	Test 2	Test 3	Test 4	Test 5
Light Vehicle (ABS)	-0.45	-0.48	-0.42	-0.45	-0.44
Haul Truck (ABS?)	-0.39	-0.36	-0.39	-0.33	-0.34

Avg. LV = -0.448
Avg. HT = -0.362

Ask the driver of the haul truck to define the risk level during this test. Use 3 levels – such as **good**, **hazard**, **unsafe**

Input the -Avg. Gx data in this table. Use the summary from the VC4000 screen as displayed after each test.

Water Truck Speed Speed Required to Deliver Target Watering Rate
Watering Rate **400 ml/m²**
Moisture Reading

Friction/Deceleration	Test 1	Test 2	Test 3	Test 4	Test 5
Light Vehicle					
Haul Truck					

Water Truck Speed Speed Required to Deliver Target Watering Rate
Watering Rate **800 ml/m²**
Moisture Reading

Friction/Deceleration	Test 1	Test 2	Test 3	Test 4	Test 5
Light Vehicle					
Haul Truck					

Water Truck Speed Speed Required to Deliver Target Watering Rate
 Watering Rate **1200 ml/m2**
 Moisture Reading

Friction/Deceleration	Test 1	Test 2	Test 3	Test 4	Test 5
Light Vehicle					
Haul Truck					

Define the 3-operation friction levels for the specific mining operation. Conduct testing with the benchmark light truck for continuous monitoring and optimization of haul road friction capability.

Unit will display the test data summary following each test.

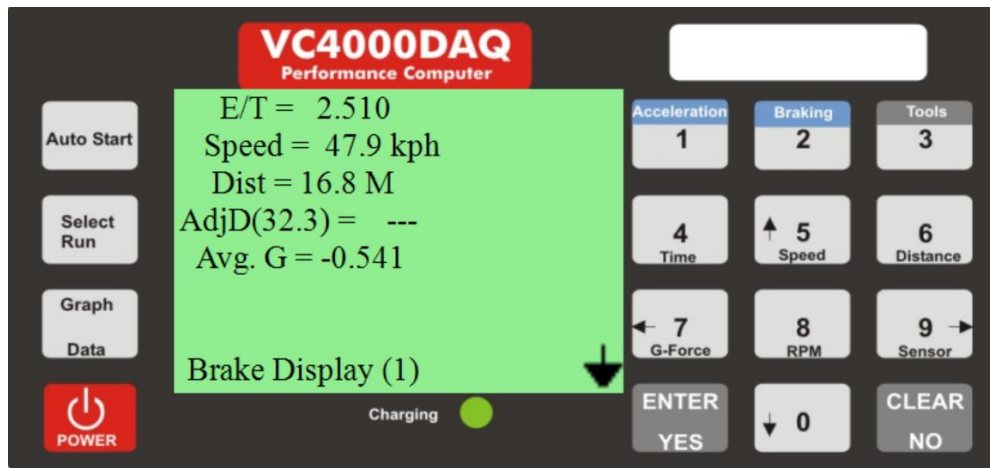
E/T = Elapsed Time for Test; 2.510 seconds in this test.

Speed = Speed at start of brake action; 47.9 KPH in this test.

Dist = Distance the vehicle traveled during test skid; 16.8 Meters for this test.

AdjD (32.3) = This is used for commercial brake efficiency testing.

Avg. G = Average deceleration (drag factor) for this test; -0.541 Gs



Basic Moisture Meter

