APPENDIX B. METHANOL QUICK RESPONSE GUIDE

B.1 Overview of Spill Characteristics, Properties, Behaviors, and Hazards

Table B-1, Table B-2, and Table B-3 provide a high-level overview of methanol spill characteristics, properties, behaviors, and hazards.

Table B-1. Methanol spill characteristics (Kass et al., 2021).

Behavior when Spilled	Dissipation or Degradation Rate	Ecological Impacts	Flammable / Explosion Risk	Toxicity	Air Displacement and Suffocation Risk To Crew	Spill Cleanup
Will rapidly spread out and dissolve into water	Fast	No long term impacts, but aquatic life in contact with spill may be poisoned	High	Yes, but limited to spill zone	Low	Will dissipate before cleanup can begin

Table B-2. Summary of key methanol properties and behaviors (ITOPF, 2024f).

	Properties	Behavior
Boiling Point	64.5 °C	At ambient conditions, methanol is a liquid.
Liquid Specific Gravity (@ 20 °C)	0.792	Methanol is less dense than water; therefore, as a liquid, methanol will float if spilled on water.
Vapor Specific Gravity (@ 20 °C)	1.1	Vapors of methanol at ambient conditions are denser than air and will spread above the ground/water surface when spilled.
Solubility	Fully miscible	Methanol has no limit to its solubility in water.
Flammability Range	6.0 - 36.5 (v/v) %	Outside of this range, the methanol/air vapor mixture is not flammable.
Flash Point	12 °C	Above this temperature, highly flammable methanol vapors are produced.

Table B-3. High-level overview of hazards associated with methanol (ITOPF, 2024g).

State		Longevity in the Environment	Toxicity to Humans	Health & Safety: Main Concerns	Protracted Response to Recover Pollutant
Under Ambient Conditions	During Transport				
Liquid	Liquid	Hours to days	Toxic (direct contact & inhalation of vapors)	Significant risks linked to toxicity and flammability	Unlikely

B.2 Responder Safety Considerations

Methanol presents several hazards to responders that differ significantly from cryogenic fuels such as LNG or hydrogen. The primary concerns are flammability, toxicity, and invisibility of the flame. Methanol has a wide flammable range (6 – 36.5% by volume in air) and a low flash point of 12 °C, which means it can ignite easily at ambient temperatures. Unlike some other fuels, methanol burns with a nearly invisible flame, making it difficult to identify burning areas without thermal imaging.

All ignition sources must be eliminated prior to response operations.

Personnel should operate from upwind positions and establish exclusion zones based on vapor detection readings.

Principal hazards include:

- Flammability: Methanol vapors ignite easily and can burn with little or no visible flame.
- Toxicity: Methanol is toxic by inhalation, ingestion, or skin absorption, and can cause systemic effects such as vision impairment and central nervous system depression.
- Vapor accumulation: Methanol vapors are slightly heavier than air and may accumulate in low-lying areas, increasing fire and exposure risks.

Personal Protective Equipment (PPE):

- Chemical-resistant suits and self-contained breathing apparatus (SCBA).
- Mandatory use of intrinsically safe equipment .

Responders should be trained to recognize symptoms of methanol exposure, which include headache, dizziness, nausea, and impaired vision.

B.3 Detection and Monitoring

Table B-4 shows how effective existing detection methodologies are for identifying methanol.

Table B-4. Summary of detection methodologies for methanol (Kass et al., 2021).

Visible	Radar	Infrared	Fluorescence	Chemical Analysis
No	No	No	No	Yes, but limited to spill zone

Detecting methanol releases requires equipment capable of identifying volatile organic compounds (VOCs). Photoionization detectors (PIDs) can detect methanol, but their effectiveness depends on the detector configuration. Standard 10.6 eV PID lamps may under-respond to methanol due to its relatively high ionization potential (~10.85 eV). For more accurate detection, PIDs should either be equipped with an 11.7 eV lamp (less common). While not ideal for precision measurement, PIDs are commonly used for general field screening.

Combustible gas indicators (CGIs) can help delineate flammable zones but may not capture methanol vapors. Thermal cameras are valuable tools for identifying methanol fires, which may otherwise be invisible. Fixed gas detection systems can be employed in facilities where methanol is stored or transferred.

Portable monitors should be used at multiple heights and positions to evaluate vapor distribution. Uncrewed aircraft systems (UAS) equipped with VOC sensors may assist in identifying the extent of vapor plumes over open areas or in difficult-to-access spaces. Visual observations should not be relied upon solely due to methanol's lack of color and flame visibility.

Continuous atmospheric monitoring is essential throughout the response. Detection data should inform the establishment of safe working perimeters and guide personnel movement in and out of the hazard area.

B.4 Fire Fighting

Methanol burns cleanly with little smoke and can be very difficult to see in low-light or open-water environments. Responders must verify extinguishment with thermal imaging.

Concerns/considerations:

- Firefighting operations involving methanol must account for the fuel’s low flash point and invisible flame.
- Use alcohol-resistant aqueous film-forming foam (AR-AFFF)
- Apply water spray to cool surrounding equipment/structures to reduce vapor formation but is not ideal for extinguishing the fire itself.
- Ventilation systems should be activated to disperse vapors, and all ignition sources, including electrical equipment, must be de-energized unless certified as intrinsically safe.
- Access to methanol safety data sheets (SDS) and pre-established firefighting protocols (e.g., Department of Transportation’s 2024 Emergency Response Guidebook, National Fire Protection Assocation Codes and standards) are essential for effective and safe operations.

B.5 Spill Response

Methanol is liquid at ambient temperature and spreads rapidly when spilled on water. Because of its complete solubility in water, containment and recovery are impractical. Traditional mechanical recovery methods such as absorbents, booms, and skimmers are ineffective. Response efforts must focus on hazard isolation, vapor suppression, and environmental protection.

Responders should implement exclusion zones and reroute vessel traffic. Water spray can be used to reduce vapor concentrations near the spill site. In confined areas, forced ventilation may be necessary to prevent vapor accumulation.

B.6 Environmental Impacts

Methanol is fully miscible in water and biodegrades readily under aerobic conditions. However, acute toxicity to aquatic organisms is possible at high concentrations. Spills in enclosed or low-energy marine environments can result in short-term effects on water quality and local biota.

Due to its solubility and volatility, methanol generally does not persist in the environment. It does not bioaccumulate and is not classified as a long-term environmental hazard. However, rapid dilution in open water may still lead to transient toxicity within the immediate spill zone.

Methanol has minimal impact on sediment and does not adhere to shorelines or accumulate in benthic habitats. Unlike oil spills, there is no visible residue, sheen, or physical fouling of surfaces. Remediation is typically not required once concentrations fall below environmental threshold values, but monitoring may be conducted to verify recovery.

Post-incident environmental assessments should document the affected area, concentration trends, and any observed impacts on aquatic life. Findings can be used to refine spill response protocols.