Storage and handling of NEODOL alcohols

NEODOL alcohols are high purity primary alcohols in the C_9 to C_{17} carbon range. NEODOL alcohols are used as feedstock for the manufacture of linear alcohol sulfates, ethoxylates, and ethoxysulfates for the production of detergents, wetting agents, dispersants and emulsifiers.

Toxicology and Safety

NEODOL alcohols can be used safely when normal industrial handling practices are followed. NEODOL products are comparable in their properties to widely used coconut oil-derived materials. Acute toxicity studies in animals show these products to be of low order toxicity. However, undiluted NEODOL products can be irritating to the eye and skin. Eye protection, such as goggles, should be used if there is the potential of contact with the eyes. Chemical resistant gloves should also be worn, as well as other protective clothing (as needed) to prevent prolonged or repeated skin contact. Any undiluted material on the skin and especially in the eyes should be removed by flushing with water. Inhalation of highly concentrated vapors of NEODOL alcohols can cause headache, dizziness, and nausea.

In general, the toxicity to aquatic organisms increases with increasing chain length up to C_{13}-alcohol, and is then limited by the solubility of the material in water. Linear alcohols are readily biodegradable and unlikely to bioaccumulate.

For more information on safe handling, consult the Material Safety Data Sheet (MSDS) for the specific NEODOL product.

Protective Equipment

	Normal operations	Spillage
Eye	Chemical monogoggles	Chemical monogoggles
Hand	Wrist length gloves; PVC, neoprene or nitrile	Gauntlet-type gloves; PVC, neoprene, or nitrile
Foot	Safety shoes or boots; chemical resistant	Safety boots, rubber, knee length Wellington type
Body	Standard issue work clothes	Chemical resistant PVC one piece suit with integral hood.
Respiratory protection	Not normally required. If ventilation is inadequate, wear respirator with organic vapor cartridge and particulate filter.	If there is a risk of inhaling aerosol / mist / sprays, wear a full face mask respirator with organic vapor canister and built in particulate filter, Nominal Protection Factor (NPF) 20 (gas only). If spillage occurs in a poorly ventilated area, wear a compressed air line mask or self contained breathing apparatus.

Fire and Spills

NEODOL products can catch fire under certain conditions. They should be kept away from heat and flames. Smoking should not be permitted where any of the NEODOL products are stored, handled or used. In the event of a small fire, carbon dioxide, foam, sand, earth, or dry chemical type fire extinguishers should be used. Larger fires should be extinguished with a water fog. Do not use water in a jet. A positive pressure self-contained breathing apparatus should be worn while fighting fires in confined areas. Other fire and spill considerations include:

- In the event of a spill or leak, remove all ignition sources
- Dike large spills. Remove all liquid by pumping into salvage tanks.
- Scoop any solidified material into disposal containers

- Spread sand or absorbent materials such as vermiculite to remove residues
- Place waste materials in leak-proof containers for later disposal

NEODOL alcohols will float on water and should be isolated and removed from the surface of the water.

NEODOL Alcohol Storage Conditions

Temperature

NEODOL alcohols are stable products, which will maintain product quality for long periods of time if properly stored. Most of the NEODOL alcohols can solidify at ambient temperatures and should be stored at temperatures at least 5°C / 10F above their pour points in order to assure good fluidity. Heating is required when the ambient temperatures fall below the pour point.

Overheating is a key variable that could have an adverse effect on product quality (eg, color degradation and carbonyl increase). Care should be taken, therefore, to store the product at the proper temperature and to use a heating medium that does not produce excessive localized temperature. The normal and maximum storage temperatures, as well as maximum skin temperatures of heating devices should not be exceeded for extended periods. It is generally recommended that NEODOL products not be stored above 50°C / 122°F for extended periods. It is best to store the products at as low a temperature as necessary to keep them fluid enough to pump and process.

The temperature of the heating medium is critical as an excessively high heat source could cause high temperature on the skin of the heating element. This could cause a charring effect of the product at the skin surface. It is recommended that the temperature of the heating medium for large storage vessels not exceed 65°C / 150°F and the temperature of the heating medium for short-term use for heating tank trucks, tank cars, and drums not exceed 115°C / 240°F (10 psia steam). For continuous storage in large vessels, tempered water (65°C / 150°F) or thermostatically controlled electric heat is recommended.

Nitrogen Blanketing

In order to help maintain maximum product quality, nitrogen blanketing of tank vapor space is recommended for long term storage. Nitrogen blanketing protects against color degradation, carbonyl formation, and water absorption. It is not a requirement, but is recommended if product is stored at elevated temperatures for long periods of time.

If storage is under air, and it is important to minimize moisture absorption, a desiccant unit can be installed in the tank vent line to dry the incoming air as the tank breathes and as air is pulled into the tank during product pump-out.

Shelf-Life

Shell does not set a shelf life or expiration date as product quality is affected by storage conditions. If NEODOL products are stored under nitrogen blanket at the recommended temperatures, they will maintain product quality for an extended period. Samples should be taken periodically and analyzed for water, color and / or carbonyls if these properties are critical to end use. Drum and smaller laboratory samples should be stored at ambient temperatures and heated only as needed. Minimal exposure to heat and air will allow products to maintain quality indefinitely.

Construction Materials and Equipment

Tanks, Piping, Valves, Pumps, Etc.

NEODOL alcohols as shipped are not corrosive to carbon steel. They may be stored and handled in steel tanks and piping. However, with the addition of excessive moisture, rusting of the carbon steel may occur. If it is critical to end usage to keep rust particles or dissolved iron out of the product, tankage may consist of either internally coated carbon steel or fiberglass-reinforced epoxy or polyester resins.

The selection of internal coating material for tanks is affected materially by the storage temperature of the product, by the method of heating and by the surface temperature of the heater. Suitable coating materials for NEODOL alcohol storage tanks having internal heating coils (usually of galvanized or stainless steel) are high baked phenolics, modified high baked phenolics, modified medium baked phenolics, or zinc silicates. If tanks are externally heated and a tank lining is preferred, then a high baked phenolic coating or a modified high baked phenolic coating is recommended.

For non-critical end usage, an acceptable alternative to tank coating could be unlined steel with a filter located in the tank discharge piping system. A replaceable polypropylene or cotton filter cartridge (50 micron) should be used for removal of any rust particles.

Carbon steel piping is acceptable; however, if products are to be rust or iron free, alternative piping should be used. Acceptable piping includes stainless steel, fiberglass-reinforced polyester or epoxy piping, polypropylene (temperature must not exceed 60°C / 140°F), or galvanized piping. Polyvinyl chloride (PVC) or chlorinated polyvinyl chloride (CPVC) piping is NOT recommended due to potential for stress cracking (particularly CPVC).

Aluminum piping / tankage is acceptable for NEODOL alcohols as long as temperatures do not exceed 60°C / 140°F. It is well known that aluminum can react with an anhydrous alcohol (particularly low molecular weight alcohols like ethanol, propanol, and butanol) at high temperatures forming aluminum alkoxide. Copper, brass or bronze pumps, valves, fittings, etc., should not be used as they can cause product discoloration.

Centrifugal, rotary, or positive displacement pumps with mechanical seals are suitable for transfer service. The pumps should be heated and insulated as appropriate. Heating the mechanical seals has been found to be helpful in preventing deposition on the seal face. Iron, steel, or stainless steels are suitable materials for pumps.

Bulk Storage	
Tank type	BHC or BLC tanks may be used. Both types should be fitted with pressure / vacuum valves to the following settings: Free standing horizontal storage tanks may also be used up to 90 m^3 capacity.
Manometer	A manometer should be fitted in order that the working of the pressure / vacuum valve may be checked.
Acceptable internal tank surface	Stainless steel Rust-free mild steel Zinc silicate coating High bake phenolic coating
Foam injection	Not required
Nitrogen blanket	Recommended
Driers	Driers should not be used as an alternative to nitrogen blanketing
Maximum storage time	Not critical
Maximum storage temperature	50°C / 122°F
Minimum storage temperature	Product should be stored at least 5°C / 10ºC above its pour point
Heating	Tanks should be fitted with heating coils in areas where the ambient temperature can fall to within 5°C / 10ºC of the product's pour point.
Cooling	Not required. Storage tanks should ideally be painted white externally.
Lagging	Tanks should be lagged to minimize heat losses.
Pumping rate	Unrestricted

	Pressure	Vacuum
BHC	5.6 kPa (56 mbar)	0.6 kPa (6 mbar)
BLC	2.0 kPa (20 mbar)	0.6 kPa (6 mbar)

Hoses and Gaskets

Suitable gasketing materials include tetrafluoroethylene (TFE), high-density polyethylene (HDPE), polypropylene (PP),

and butyl rubber. Ethylene Propylene (EPDM) elastomer can not be used in NEODOL alcohol service. Care must be taken in using any elastomer that the manufacturer's recommended temperature limit is not exceeded.

Polyethylene, polypropylene, TFE, or butyl rubber lined transfer hoses are recommended for use with these products - as are stainless steel flex hoses. Unheated hoses, after use, must be drained to avoid solidification and consequent plugging.

Full bore ball valves should be used for pigged or sphered pipelines. For other than pigged or sphered pipelines gate valves, butterfly valves or ball valves may be used. Material may be stainless steel, cast iron or cast steel. Recommended valve packing is graphite, lubricated PTFE or equivalent.

Heating Systems

For large installations involving bulk storage, the preferred method of heating is by means of tempered hot water. Complete, packaged hot water systems are available. If desired, inexpensive hot water systems are available for small installations. These systems consist of a residential or commercial type water heater, equipped with a small circulation pump, surge tank and controls.

Thermostatically controlled electric resistance heating may be used for "wrap-around" external heating of insulated metal storage tanks. This method of heating is appropriate for maintaining temperatures, or where a very small increase in product temperature is required. Similarly, this method is recommended only for the maintenance of the existing product storage temperature in insulated fiberglass reinforced plastic tanks. However, its relative ease of installation and freedom from maintenance may make it attractive within its limitations. The same attributes usually make electrical heat tracing of piping, valves, pumps, etc., the preferred method of heating this equipment. Electric heat tracing is obtainable from a number of sources.

Drums of NEODOL alcohol can be stored at ambient temperatures and, if necessary, can then be heated prior to use by storage in a "hot room" or by the application of low level heat. Drums may be heated in a number of ways: steam blowing under a tarpaulin cover, in an oven, or special thermostatically controlled external type electrical or hot water type heater designed to wrap around 55-gallon drums. Individually 110-120 volt electrical heaters for heating drums are available at a low cost. Care should be taken not to overheat drums and allowance made for product expansion as it is heated in the drum. In no case should product be heated over 60°C / 140°F as product expansion could cause the drum fill capacity to be exceeded.

Drums, Totes (Intermediate Bulk Containers), and ISO-Containers

US DOT specification drums are not required for non-regulated product (refer to the MSDS for complete shipping information). The type of drum used will be dependent upon the particular product's freezing point or pour point, and the ultimate ability to heat drums. In some instances, plastic drums can be used, but particular attention should be paid to the product freeze point, as heating of plastic drums is not generally recommended. It is recommended that only steel drums (not plastic) be used for export shipments.

Bulk transport, North America

Tank Cars

Tank cars for NEODOL alcohols must conform to national or international transport regulations as appropriate. In the US, all tanks cars have the following features:

- Externally coiled
- Insulated with a minimum of 4 inches of fiberglass insulation
- Dual purpose, with both top and bottom loading and unloading
- Carbon steel tank, interior coated with a high baked phenolic coating
- Tank bottom is sloped to center for complete drainage
- Bottom outlet has a 4-inch internal stainless steel ball valve equipped with a standard American Association of Railroads fitting having 5 1 / 4-inch diameter threads
- Vapor connection on top with a 1-inch ball valve

All tank cars are equipped with a tank relief valve and heater coil relief valves. The tank relief valve is set at 75 psig (this setting is stenciled on the sides of each car). Low-pressure steam (115°C / 240°F) should be used to heat the product as higher-pressure steam could cause product discoloration due to overheating in area adjacent to steam coils.

Tank Trucks

Tank trucks for NEODOL alcohols are constructed of either stainless steel or aluminum. If aluminum, the metal wall temperature must be kept below 65°C / 150°F and the NEODOL alcohol should contain, at least 120 ppm water (due to possible reaction of anhydrous alcohols with aluminum at high temperature). Low pressure steam (115°C / 240°F), or tempered water should be used to heat the product, as the use of higher pressure steam could cause product discoloration due to overheating. Coiled aluminum equipment is not as readily available as coiled stainless steel equipment. Preferably the tanks are insulated. From September through May, in transit heating equipped trailers in the US will be provided for the low pour point products to assure that product arrives at an adequate temperature to stay in a fluid / pumpable condition. The trailers will be equipped with temperature sensing devices so that the product temperature can be monitored to assure proper transport temperature. In transit heat is designed to maintain product temperature as opposed to heating the product. There is no guarantee that the product will arrive at the preferred temperature.

When ordering products by truck, special requirements should be specified in advance. Special requirements could include abnormal size or type of hose connection, a need for more than the normal hose accompanying a truck (due to unloading spot location), or vapor connections for introduction of inert gas into the tank truck during discharge. If pressure unloading is to be used, please specify the desired tank pressure relief valve setting required, as they vary from tank to tank.

Bulk transport, outside North America (Road and Rail)	
Type	Rail and Road Tank Cars and Isotanks must conform to national or international transport regulations as appropriate.
Acceptable internal tank surface	Stainless steel Aluminum
Filling / discharge temperature	Minimum 5°C / 10ºF above product's pour point
Method of filling	Unrestricted When loading at facilities where Class I or II products are also loaded or parked, Road Tank Cars must be fitted with a battery isolation switch which must then be used to switch off the electrical system of the vehicle.
Method of discharge	Gravity, pump, dry compressed air or nitrogen
Product dedication	Not required

Bulk Movement by ship		
Vapor return line during loading	Not a mandatory transport regulatory requirement, however, if required by operating license / local requirements, specific locations may demand it or a closed loading system.	
Acceptable internal tank surface	Stainless steel Zinc silicate coating Epoxy or high baked phenolic coaing	
Shipping temperature	NEODOL 23	25 – 35 °C
	NEODOL 25	30 – 40 °C
	NEODOL 45	35 - 45 °C

	NEODOL 91 or 67	ambient
Loading and discharge temperature	Minimum 5°C / 10ºF above product's pour point	
Maximum product temperature	60°C / 140°F	
Minimum product temperature	Should be maintained at 5°C / 10ºF above product's pour point	
Nitrogen blanketing	Required	
Reference source	International Safety Guide for Oil Tankers and Terminals (ISGOTT)	

Typical physical properties and temperature requirements

NEODOL Alcohol		79	91	1	23	25	45	67
Melting range	**° C**	-52 to -42	-16 to -4	6 to 14	7 to 22	12 to 25	15 to 35	-25 to -12
	° F	-61 to -44	3 to 25	42 to 57	45 to 72	54 to 77	60 to 95	-5 to 8
Pour point	**° C**	-46	-12	11	15	20	29	-15
	° F	-51	10	52	59	68	84	5
Flash point (PMCC)	**° C**	77	108	121	135	149	157	169
	° F	171	225	250	275	300	315	336
Recommended storage temp (minimum)	° C	-37	-5	19	24	28	35	-5
	° F	-35	23	65	75	80	95	23
Recommended storage temp (maximum)	**° C**	38	38	48	48	50	50	38
	° F	100	100	120	120	122	122	100

Regulations Affecting Storage, Handling and Shipping

NEODOL products must be stored and handled in accordance with local and federal regulations. The following regulations are applicable:

The alcohols concerned (not including NEODOL 79) all have flash points greater than 200 ºF (PMCC) and are rated as Class III B combustible liquids by the NFPA No. 30.

For Hazardous Materials / Dangerous Goods classifications per the US Department of Transportation (DOT), the International Air Transportation Association (IATA) and the International Maritime Dangerous Goods Code (IMDG) please refer to the product MSDS. Compliance with applicable regulations assures proper product identification, packaging, documentation, storage, and transportation.

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