

Storage & Handling Guide

March 2024

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Introduction

MIDEL eN 1204 and MIDEL eN 1215 are robust natural ester liquids. Studies have demonstrated their long-term stability, even at elevated temperatures in sealed systems. They have been successfully used worldwide, and are recommended in non-breathing transformer systems. As with all dielectric liquids, it is necessary to take precautions when handling and storing MIDEL eN liquids to ensure that they are kept in optimum condition.

Miscibility

Miscibility gives an indication of the compatibility between different liquids. MIDEL eN liquids are fully miscible with transformer mineral oil, high molecular weight hydrocarbons and other transformer ester liquids. They are not miscible with silicone oil. If unsure about the miscibility of a specific insulating liquid with MIDEL eN liquids, please contact the MIDEL technical department at mideltech@midel.com for recommendations.

Receiving

We deliver MIDEL eN liquids in a range of industry-approved packaging/sizes. Please contact customer service to discuss your requirements.

With the IBCs/totes it is possible that users may notice a slight deformation of the containers. This is due to the liquid absorbing the small amount of air in the headspace, thus creating a vacuum. This is perfectly normal and a good indication that the seal has not been compromised. In contrast drums of MIDEL eN are not likely to deform. This lack of deformation does not mean that the drum seal has been compromised.

The vacuum seal in IBCs/totes needs to be broken and the recommendation is to contact IBC supplier Schütz to obtain the correct lid removal tool (part no.16659).

It is recommended that MIDEL eN liquids not be stored for a period greater than 6 months in the flexitanks, but instead transferred to a suitable tanker truck or fixed storage tanks.

Storage

If properly stored indoor in temperature climate of 10°C to 40°C and away from direct exposure to sunlight, unopened containers of MIDEL eN liquids have a shelf life of 10 years. Once opened, precautions should be taken to avoid contact with moist air for prolonged periods because the liquid is hygroscopic and will absorb atmospheric moisture. If a partially emptied container is used for storage the head space should ideally be back-filled with dry nitrogen or dry air prior to resealing. Additionally, it is important to ensure the lid is properly sealed.

It should be noted that MIDEL eN liquids are robust dielectric liquids which will give many years of service in transformer applications and the shelf-life figure of 10 years is given as a guideline only. This not a strict limitation on the length of time that MIDEL eN liquids can be stored for and if stored beyond this time users can establish the suitability of the liquid for service by checking properties such as water content and breakdown voltage. It is fully expected that in a well-maintained transformer, the MIDEL liquid will provide many years of good dielectric performance, and that the length of the MIDEL working life is not limited to the stated shelf life.

STORAGE TANK & TANKER TRUCK HANDLING

Cleaning:

For a storage tank or tanker truck previously filled with transformer mineral oil, it is recommended to thoroughly clean it before filling it with MIDEL eN liquids. If steam cleaning is performed, ensure that the storage tank or tanker truck is completely dry before filling it with MIDEL eN liquids. If MIDEL eN is used to flush remaining transformer mineral oil from a storage tank or tanker truck then the user must ensure that a sufficient volume of MIDEL eN is used to remove all residual transformer mineral oil. A rinse of MIDEL eN of the bottom pipelines and valve and or pump on the storage tank or tanker truck system is also recommended.

Inspection:

The storage tanks and tanker trucks should be inspected to ensure that the tank is clean and free of contaminants. Contaminants may include but are not limited to dust, paint, rust, fabrication debris, oil sludge or water. Inspection of MIDEL eN should be done to similar methods as transformer mineral oil. Before filling the tanker, certificate of compliance by the supplier should be checked to make sure that MIDEL eN meets all the specification requirements.

Headspace:

The headspace of the tank should ideally be filled with dry nitrogen. Ensure the valves are properly shut off and covered to help keep the liquid dry.

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Unloading:

MIDEL eN liquids should be unloaded using similar methods as transformer mineral oil, but attention should be paid to the filters, pumps, valves, seals, and hoses. Dedicated equipment for MIDEL eN will yield optimal performance.

Filtration:

MIDEL eN liquids should be filtered before filling the tanker truck and after unloading it in the storage tank or in a transformer. The filters recommended for MIDEL eN are 1 micron of a type suitable for use with transformer oil. A cartridge type filter with a synthetic filter medium may be used. If unsure about a particular filter, please contact the MIDEL technical department for recommendation. A good general practice is to filter MIDEL eN every time it is transferred.

Hoses, Seals, Pumps and Valves:

All the hoses, seals, pumps, and valves should be compatible with MIDEL eN liquids. A material compatible list is available on the [midel.com](https://www.midel.com/products/midel/mid-el-en/materials-compatibility-2) website. The link is provided below:
<https://www.midel.com/products/midel/mid-el-en/materials-compatibility-2>

The recommended hoses to use for pumping MIDEL eN liquids are: Goodyear SAE J30R3 (Inner only compatible), Gates Premoflex, Trelleborg Chemikler D-UPE (Inner only compatible). If the user is interested in using any other hoses, please contact the MIDEL technical department to check for compatibility prior to use.

The seals recommended for use with MIDEL eN liquids are: Nitrile Rubber (BS2751), Silicone Rubber, Polyurethane Rubber, Fluorocarbon Rubber (Viton), PTFE (Teflon), Nylon and Fluorosilicone. If the user is interested in using any other

seals, please contact the MIDEL technical department to check for compatibility prior to use.

Valves suitable for use with transformer mineral oil should be suitable for use with MIDEL eN. If unsure about a particular valve, please contact the MIDEL technical department.

Any power take-off (PTO) pump attached to the tanker truck or any auxiliary pump that is suitable for operation with transformer mineral oil may be suitable for MIDEL eN. The viscosity of MIDEL eN liquids is higher than transformer mineral oil at ambient temperatures and this must be taken into account when specifying pumping systems. A higher capacity pump will be needed to maintain the same flow rate as transformer mineral oil at a given temperature. Table 1 shows viscosity values versus temperature for reference.

As with any dielectric liquid there is a possibility of static charge build up when MIDEL eN liquids are flowing through the pipes. The user should ensure that all pumps, lines and vessels are adequately bonded and earthed during pumping operations.

It is highly recommended to have dedicated hoses and pumps for MIDEL

eN liquids. This will prevent cross-contamination. In the case where same hoses and pumps are used for transformer mineral oil and MIDEL eN, it is recommended to thoroughly flush the hoses and pumps with MIDEL eN prior to use and to discard the liquid used for flushing.

Transformer Filling and Cellulose Impregnation

To avoid air entrapment in the transformer cellulose the tank should be filled from the bottom or if possible, under vacuum.

In order to aid impregnation of the cellulose it is recommended that MIDEL eN liquids be heated to between 60°C and 80°C when filling. At 60°C the viscosity of the liquid is very close to that of transformer mineral oil at 20°C, and a similar impregnation rate has been observed in laboratory testing. It is further recommended that the transformer is filled slowly to aid impregnation and left for at least 24 hours prior to energising for the first time.

Throughout all stages of the filling operation, it is essential that the introduction of moisture or particulate matter be avoided. The outlet side of any pump used during filling should be

Table 1 - Viscosity Values Versus Temperature

Temperature °C	MIDEL eN 1204 Kinematic Viscosity mm ² /s	MIDEL eN 1215 Kinematic Viscosity mm ² /s
0	235	207
20	85	67
40	37	32
60	19	18.6

Data quoted above are typical values

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protected by a fine mesh or paper element filter. The use of degassing and vacuum filling is possible with MIDEL eN, using the same type of equipment and methods employed with transformer mineral oil.

Oxidation Stability and Handling Considerations

The oxidation stability of natural esters, including MIDEL eN 1204 and MIDEL eN 1215, is inferior to that of mineral oil or synthetic esters such as MIDEL 7131. Within a non-free breathing transformer application, MIDEL eN 1204 and MIDEL eN 1215 are suitable dielectric liquids, and are expected to perform for the life of the transformer. During handled outside of a transformer, oxidation may take place after extended periods of continuous contact with oxygen in the air. Subsequently, diligence and good housekeeping practices must be maintained to minimize the amount of continuous contact with air. Most notably, active parts impregnated with MIDEL eN liquids must not be dried in a hot air-drying oven.

When natural esters oxidize, the resultant impact may be experienced as follows:

- ▶ Thin films: If a surface has been coated with MIDEL eN and is continuously exposed to the air, the liquid will start to become tacky (sticky) after a number of days. With additional time (weeks), the liquid on the surface will begin to polymerize & will eventually result in a varnish.
- ▶ Moving liquid volume: If a body of MIDEL eN is in motion and exposed to the air the viscosity of the liquid will increase over a period of time; the liquid will not become tacky or polymerize.

Practical recommendations for the handling of MIDEL eN liquids:

- ▶ Transformers exposed to MIDEL eN and drained – options to minimize the potential for thin film oxidation include:
 - rinsing the tank and core/coil assembly with MIDEL 7131 (to remove residual MIDEL eN from the surfaces)
 - placing the transformer/assemblies within a large plastic bag & filling the bag with dry nitrogen
 - placing the transformer assemblies in a volume of liquid.
- ▶ Service equipment that contained and/or processed MIDEL eN liquids – recommendations include:
 - All tank surfaces and hoses should be rinsed with mineral oil or MIDEL 7131 to remove any residual MIDEL eN
 - Processing equipment should be flushed with either mineral oil or MIDEL 7131 to purge the residual MIDEL eN and remove any residual product from surfaces.

Equipment used in the handling and processing of MIDEL eN should be rinsed, flushed, or cleaned after use.