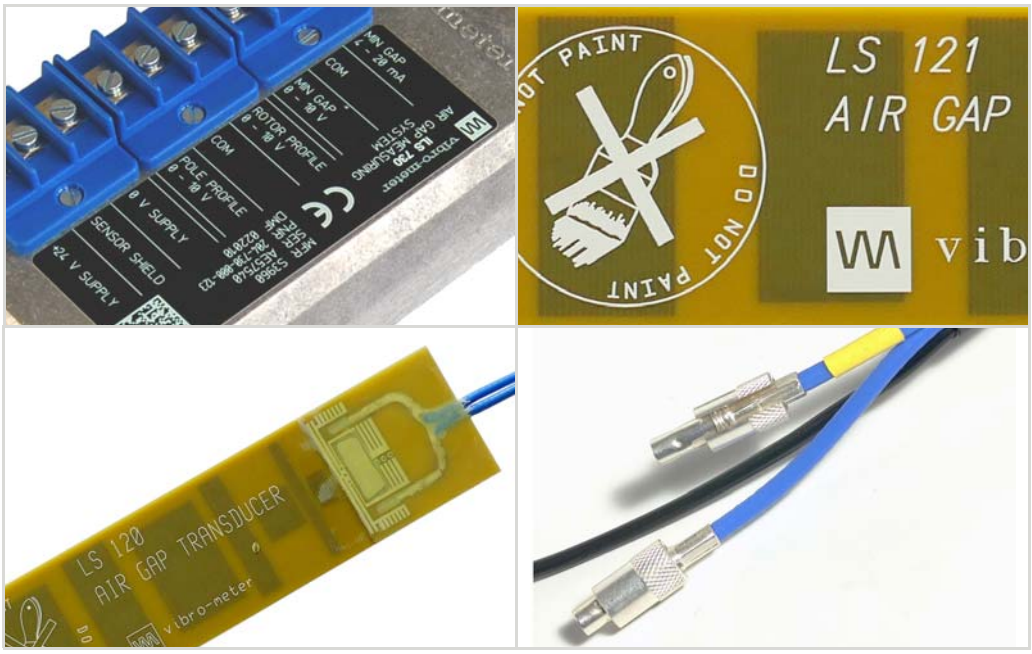
Parker MEGGiTT

INSTALLATION MANUAL

vibro-meter®

Air-gap measurement chains using LS12x air-gap sensors with ILS73x signal conditioners



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PREFACE

About this manual

This manual describes how to install air-gap measurement chains using LS12x air-gap sensors (transducers) with ILS73x signal conditioners, from Parker Meggitt's vibro-meter® product line.

It also describes the general use of these LS12x-based air-gap measurement chains.

About Parker Meggitt and vibro-meter®

Parker Hannifin Corporation – usually referred to as just Parker – is a global leader in motion and control technologies, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. For more than a century the company has been enabling engineering breakthroughs that lead to a better tomorrow.

Parker Meggitt joined the Parker Aerospace Group in September 2022 following the successful acquisition of Meggitt PLC, a world leader in aerospace, defense and energy. This included the Meggitt facility in Fribourg, Switzerland, operating as the legal entity Meggitt SA (formerly Vibro-Meter SA). Accordingly, the vibro-meter® product line is now owned by Parker.

Working closely with its customers, Parker Meggitt delivers technologically differentiated systems and products for the most demanding environments with high certification requirements for applications across its core end markets: aerospace, energy and industrial.

For the energy market (power generation, oil & gas and other industrial markets), vibro-meter® products and solutions include a wide range of vibration, dynamic pressure, proximity, air-gap and other sensors / measurement chains capable of operation in extreme environments, machinery protection and condition monitoring systems, and innovative software.

To learn more about Parker Meggitt (Meggitt SA), our proud tradition of innovation and excellence, and our solutions for energy markets and applications, visit our website at www.meggittsensing.com/energy

Who should use this manual?

The manual is intended for use by qualified personnel, such as mechanical and electrical fitters, and operators of monitoring/control systems.

NOTE: Personnel involved in the installation, operation and maintenance of Parker Meggitt vibro-meter® systems are assumed to have the necessary technical training in electronics and/or mechanical engineering (professional certificate/diploma or equivalent) to enable them to install, configure, use and/or maintain the system correctly and safely.

Adhere to the instructions!

The procedures described in this manual should be strictly adhered to in order to ensure the LS12x air-gap sensors, ILS73x signal conditioners, cabling and associated equipment are properly installed. This ensures that measurement signals are reliable and systems function as intended.

The user should also adhere to general safety procedures as well as general and specific machine constructor guidelines and instructions.

Limitations of this document

Not all mounting and connection possibilities are described in this manual. Nevertheless, several specific configurations are described in detail. These can often be adapted to specific applications. Contact your local Parker Meggitt representative or Parker Meggitt (Meggitt SA) for further information.

Related documentation

Further information on products can be found in their corresponding data sheets, which are available from our website at www.meggittsensing.com/energy or can be obtained from your local Parker Meggitt representative.

NOTE: To ensure that the latest version of documentation is being used, visit the Parker Meggitt website at www.meggittsensing.com/energy and check for any updates. Alternatively, contact your local Parker Meggitt representative.

SAFETY

Symbols and styles used in this manual

The following symbols are used in this manual where appropriate:

The WARNING safety symbol

THIS INTRODUCES DIRECTIVES, PROCEDURES OR PRECAUTIONARY MEASURES WHICH MUST BE EXECUTED OR FOLLOWED. FAILURE TO OBEY A WARNING MIGHT RESULT IN INJURY TO THE OPERATOR AND/OR THIRD PARTIES, AND/OR RESULT IN DAMAGE TO EQUIPMENT.

The CAUTION safety symbol

This draws the operator's attention to information, directives or procedures which must be executed or followed. Failure to obey a caution can result in damage to equipment.

The ELECTROSTATIC SENSITIVE DEVICE symbol

This indicates that the device or system being handled can be damaged by electrostatic discharges.
See Handling precautions for electrostatic sensitive devices on page ix for further information.

NOTE: This is an example of the NOTE paragraph style. This draws the operator's attention to complementary information or advice relating to the subject being treated.

Important remarks on safety

FAILURE TO FOLLOW THE INSTRUCTIONS AND IMPLEMENT THE RECOMMENDATIONS IN THIS MANUAL MIGHT RESULT IN INJURY TO THE OPERATOR AND/OR THIRD PARTIES, AND/OR RESULT IN DAMAGE TO EQUIPMENT AND WILL INVALIDATE ANY WARRANTY.

Read this manual carefully and observe the safety instructions before installing and using the equipment described.

By doing this, you will be aware of the potential hazards and be able to work safely, ensuring your own protection and also that of the equipment.

Every effort has been made to include specific safety-related procedures in this manual using the symbols described above. However, operating personnel are expected to follow all generally accepted safety procedures.

All personnel who are liable to install, operate and/or maintain the equipment described in this manual should be trained in the correct safety procedures.

Parker Meggitt does not accept any liability for injury or material damage caused by failure to obey any safety-related instructions or due to any modification, transformation or repair carried out on the equipment without written permission from Parker Meggitt (Meggitt SA). Any modification, transformation or repair carried out on the equipment without written permission from Parker Meggitt will invalidate any warranty.

Electrical safety and installation

WHEN INSTALLING A LS12X-BASED AIR-GAP MEASUREMENT CHAINS, OBSERVE ALL SAFETY (WARNING AND CAUTION) STATEMENTS IN THIS MANUAL, AS APPROPRIATE, AND FOLLOW ALL NATIONAL AND LOCAL ELECTRICAL CODES. SEE 1.5 RELATED DOCUMENTATION FOR A LIST OF INSTALLATION MANUALS.

ONLY TRAINED AND QUALIFIED PERSONNEL (SUCH AS A QUALIFIED/LICENSED ELECTRICIAN) SHOULD BE ALLOWED TO INSTALL OR REPLACE THIS EQUIPMENT. CHECKS TO ENSURE ELECTRICAL SAFETY SHOULD BE CARRIED OUT BY A COMPETENT PERSON.

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN DEATH, SERIOUS INJURY, AND/OR EQUIPMENT DAMAGE.

Equipment installed in potentially explosive atmospheres

THIS MANUAL COVERS EQUIPMENT THAT CANNOT BE USED IN POTENTIALLY EXPLOSIVE ATMOSPHERES (HAZARDOUS AREAS), THAT IS, EQUIPMENT THAT IS SUITABLE FOR STANDARD APPLICATIONS IN NON-HAZARDOUS AREAS ONLY.

General handling precautions

Parker Meggitt's air-gap sensors and signal conditioners are rugged devices which can withstand a certain amount of careless handling. However, certain precautions should be taken when handling this equipment

Read the following recommendations carefully before handling air-gap sensors and signal conditioners.

- Do not drop the sensor (transducer) or the signal conditioner onto a hard surface or subject them to violent shocks.
- Protect the sensor and the signal conditioner with protective material when they are being handled, stored or transported. Remove this protection only when installing the sensor or signal conditioner or when inspecting or testing them.
- Check for dents when inspecting the sensor and signal conditioner as this is a sign that they could have suffered a physical shock by impact. This may have caused damage to components within the sensor or signal conditioner.
- Do not excessively bend the sensor or signal conditioner cable or associated cables. Adhere to the minimum bend radius quoted in the corresponding data sheet.
- When storing and using the equipment, adhere to the environmental specifications (temperature, humidity) quoted in the corresponding data sheet.
- See also Handling precautions for electrostatic sensitive devices on page ix.

Handling precautions for electrostatic sensitive devices

Certain devices used in electronic equipment can be damaged by electrostatic discharges resulting from built-up static electricity. Because of this, special precautions must be taken to minimize or eliminate the possibility of these electrostatic discharges occurring.

Read the following recommendations carefully before handling electronic circuits, printed circuit boards or modules containing electronic components.

- Before handling electronic circuits, discharge the static electricity from your body by touching and momentarily holding a grounded metal object (for example, a pipe or cabinet).
- Avoid the build-up of static electricity on your body by not wearing synthetic clothing material, as these tend to generate and store static electric charges. Cotton or cotton blend materials are preferred because they do not store static electric charges.
- Do not handle electronic circuits unless it is absolutely necessary. Only hold modules by their front panel handles.
- Do not touch printed circuit boards, their connectors or their components with conductive devices or with your hands.
- Put the electronic circuit, printed circuit board or module containing electronic components into an antistatic protective bag immediately after removing it from the system rack.

Replacement parts and accessories

Use only approved replacement parts and accessories.

Do not connect with incompatible products or accessories.

Only use replacement parts and accessories intended for use with LS12x-based air-gap measurement chains that have been approved by Parker Meggitt (Meggitt SA).

Using incompatible replacement parts and accessories could be dangerous and may damage the equipment or result in injury.

For information on replacement parts and accessories:

- Visit the Parker Meggitt website at www.meggittsensing.com/energy
- Contact your local Parker Meggitt representative.

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1 INTRODUCTION TO LS12X-BASED AIR-GAP MEASUREMENT CHAINS

1.1 System description

LS12x-based air-gap measurement chains are designed for the contactless measurement of air gap – that is, the distance between the rotor and the stator (on which the sensor is fixed) – in hydroelectric generators, and other large alternators and motors.

A LS12x-based air-gap measurement chain consists of a LS12x air-gap sensor with integral cable and a ILS73x signal conditioner. A range of LS12x air-gap sensors and ILS73x signal conditioners are available with different measurement ranges (see Figure 1-1 and 1.8.1 LS12x air-gap sensors).

Importantly, LS12x-based systems are designed for operation in the presence of high-strength magnetic fields typically found in hydroelectric generators.

(a) LS120 air-gap sensor

(b) LS121 air-gap sensor

(c) ILS73x signal conditioners

Figure 1-1: LS12x air-gap sensors and ILS73x signal conditioners

As shown in Figure 1-2, a LS12x air-gap sensor has an integral cable of either 5 or 10 m length which is used for the connection to a ILS73x signal conditioner.

Figure 1-2 also shows the separate 1 m long ground wire that is part of the integral cable. This ground wire must be very well connected to the machine ground in order to help ensure the correct operation of the air-gap measurement chain.

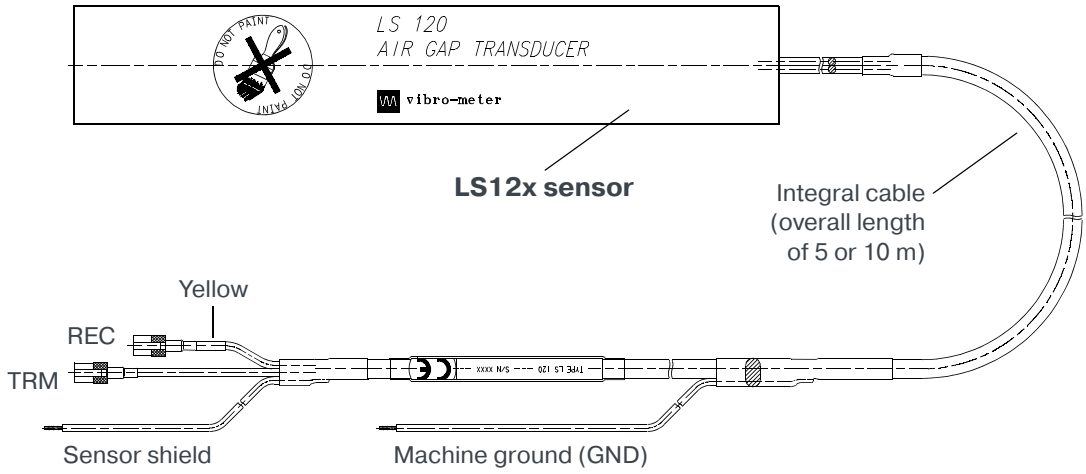

Figure 1-2: LS12x air-gap sensor and integral cable

NOTE: The choice of LS12x air-gap sensor with a 5 or 10 m integral cable length is made at the time of ordering. The air-gap sensor and integral cable cannot be subsequently modified.

NOTE: The choice of ILS73x signal conditioner for operation with a total system length (TSL) of 5 or 10 m (that is, operation with a LS12x with 5 or 10 m cable) is made at the time of ordering. The signal conditioner cannot be subsequently modified.

Parker Meggitt's vibro-meter® air-gap measurement chains are tuned systems and the length of the cable from the LS12x air-gap sensor to the ILS73x signal conditioner is selected at the time of ordering. It is not possible to mix and match individual components from other manufacturers.

1.2 Operating principle

A LS12x air-gap sensor is an electric field sensor (transducer) with two electrodes – a transmitter electrode and a receiver electrode – which are capacitively coupled (see Figure 1-3).

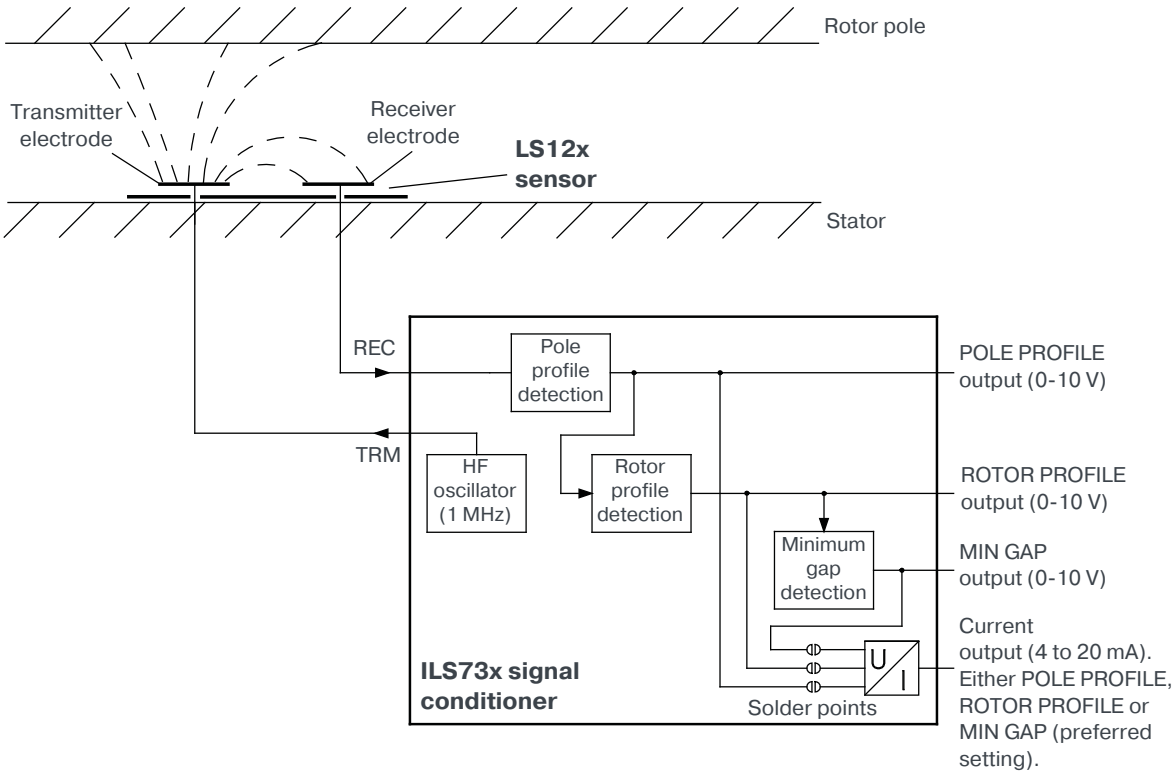

Figure 1-3: Block diagram of LS12x and ILS73x air gap measurement chain

The LS12x air-gap sensor's transmitter electrode is excited by a 1 MHz signal provided by the electronic circuitry of the ILS73x signal conditioner. This provides the high-frequency electric field that is detected by the receiver electrode. The coupling between the transmitter and the receiver is modulated (modified) each time a rotor pole passes the electrodes.

NOTE: For correct operation, the rotor must be made from a conductive material and be very well grounded.

The system provides three voltage-based outputs (0 to 10 V), which are available on a screw-terminal strip of the ILS73x signal conditioner:

- The POLE PROFILE output indicates the instantaneous value between the sensor and the rotor.
- The ROTOR PROFILE output indicates the minimum value of the air gap for each pole.
- The MIN GAP output reflects the minimum air gap value for all poles of the rotor.

See 1.5 ILS73x signal conditioner outputs for a more detailed explanation.

In addition, the system provides one current-based output (4 to 20 mA) for use with any one of the above three signals. This output is also available on the screw-terminal strip of the ILS73x signal

conditioner. The selection between POLE PROFILE, ROTOR PROFILE and MIN GAP is made by factory-set solder points which are placed according to the ordering option codes.

The ILS73x signal conditioner screw-terminal strip also contains terminals for the required external power supply, which is nominally +24 V_{DC}.

1.3 Measured air gap and true air gap

A LS12x-based air-gap measurement chain measures the distance between the surface of the LS12x sensor and the surface of the rotor (see Figure 1-4). It is therefore important to make a distinction between this “measured air gap” and the “true air gap”.

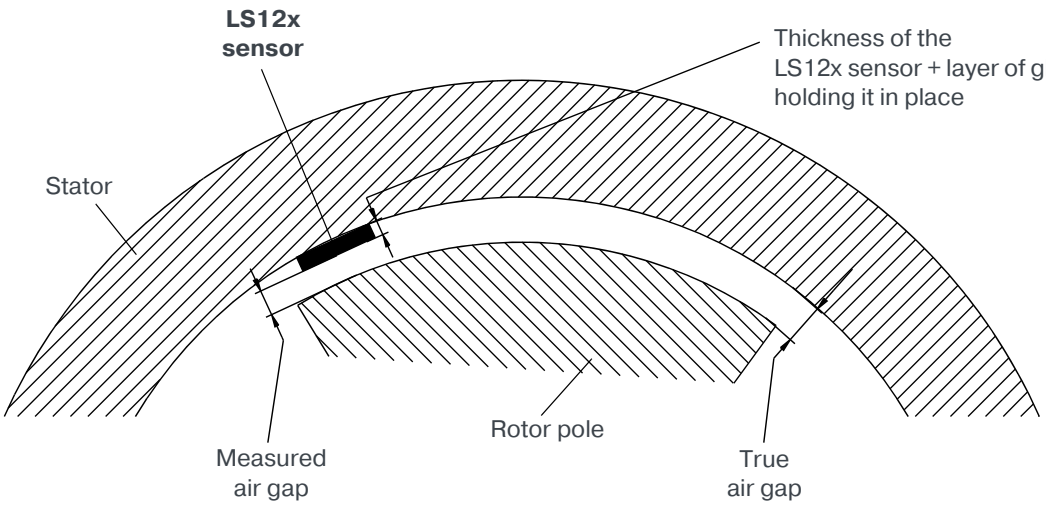

Figure 1-4: Measured air gap and true air gap

The true air gap is calculated as follows:

True air gap = Measured air gap
+
Thickness of the LS12x sensor
+
Thickness of the layer of glue holding the LS12x sensor in place

Where:

The thickness of LS12x sensors can be found in the corresponding data sheet.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information.

The thickness of the layer of glue holding LS12x sensors in place is typically 0.1 to 0.5 mm but should be measured in situ after installation in order to ensure accurate true air gap measurements.

The additional thickness due to the sensor and the glue should always be taken into account when the true air gap is being considered.

1.4 LS12x sensor types and transfer characteristics

The LS12x sensors are optimised for a specific measurement range and must be used with a signal conditioner that has a matching gain and offset. For this reason, a LS12x sensor can only be used with the associated ILS73x signal conditioner. More specifically, a LS120 requires a ILS730 and a LS121 requires a ILS731 (see 1.8.2 ILS73x signal conditioners).

A LS12x and ILS73x air-gap measurement chain is delivered with either a 5 or 10 m long integral cable (that is, integral cable of the sensor). This combination is calibrated in the factory and does not require any further on-site calibration.

It is possible to interchange (replace/swap) LS12x sensors or ILS73x signal conditioners of the same type. In which case, the measurement precision (typically ⩽±5% of FSD) is still guaranteed.

NOTE: It is not possible to interchange (replace/swap) LS12x sensors or ILS73x signal conditioners of a different type. For example, it is not possible to interchange:
- LS12x sensors with different integral cable lengths (5 m for 10 m or vice versa).
- LS12x sensors of a different type (LS120 for LS121 or vice versa).
- ILS73x signal conditioners of a different type (ILS730 for ILS731 or vice versa).

The output signal provided by the system (whether voltage-based or current-based) is almost directly proportional to the air gap. Refer to the transfer characteristic given in the corresponding data sheet.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information.

1.5 ILS73x signal conditioner outputs

The following signals are available on the ILS73x signal conditioner: POLE PROFILE, ROTOR PROFILE and MIN GAP. Figure 1-5 shows the relationship between these three signals (for a 50 Hz alternator).

1.5.1 POLE PROFILE

The POLE PROFILE output corresponds to the instantaneous air gap measured by the LS12x sensor. It is a raw, wide-band (1 kHz) signal.

The POLE PROFILE signal can be used for machine diagnostics and/or condition monitoring purposes.

1.5.2 ROTOR PROFILE

The ROTOR PROFILE output provides information on the minimum gap value measured successively on each pole. It is a semi-dynamic signal consisting of steps, which is derived from the raw POLE PROFILE signal inside the ILS73x signal conditioner.

The minimum air gap for each pole is latched, and made available to the user until the time when the next pole passes over the sensor. Note that for this reason the ROTOR PROFILE value lags the POLE PROFILE value by one pole (that is, 10 ms for a 50 Hz machine or 8.33 ms for a 60 Hz machine). The latching is synchronised to the edge of each pole, and occurs when the signal crosses the trigger level of +10 V.

The ROTOR PROFILE signal is normally used for system checking and/or condition monitoring purposes.

1.5.3 MIN GAP

The MIN GAP output corresponds to the overall minimum gap value obtained from the raw POLE PROFILE signal. It takes into consideration all poles of the rotor. The MIN GAP signal changes almost instantaneously when a smaller gap value is measured on the raw signal. A slow decay time of 50 seconds ensures that these peak values (minimum gap values) are memorised by the system. It is a quasi-static signal.

The MIN GAP signal is normally used by a machinery protection system.

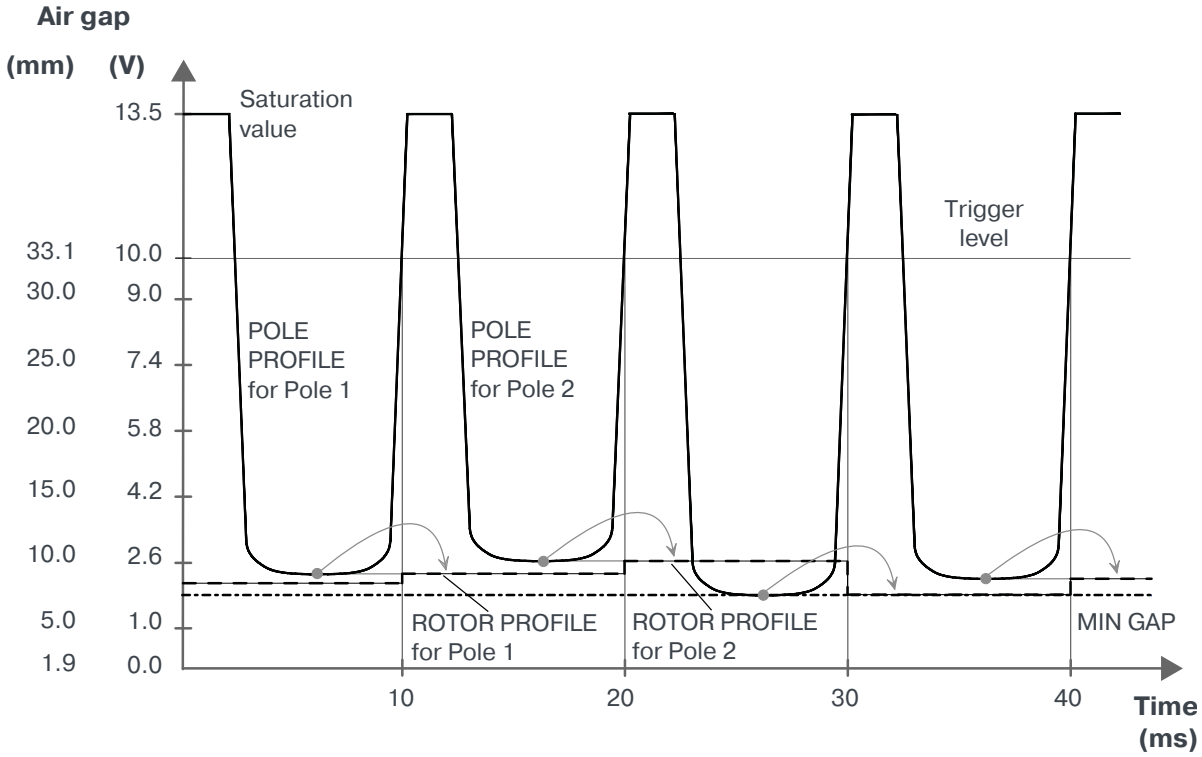

Figure 1-5: POLE PROFILE, ROTOR PROFILE and MIN GAP signals (example for a 50 Hz alternator)

1.6 Intended machine types

The LS12x-based air-gap measurement chain was designed essentially for air-cooled alternators. It is not possible to install the system in large turbo-alternators that have few poles (for example, only two or four) as these machines are normally hydrogen-cooled.

This system is principally intended for machines turning at speeds up to 1500 RPM (that is, having four poles or more) and is ideally suited to slow-turning large diameter hydro-alternators with multiple poles.

The choice of measurement chain depends on the rotating machine's nominal air gap and the required measurement range.

1.7 Measurement chain overview

This section provides an overview of air-gap measurement chains using LS12x sensors and ILS73x signal conditioners, from Parker Meggitt's vibro-meter® product line. The range of LS12x-based measurement chains is summarised in Table 1-1.

Table 1-1: Examples of air-gap measurement chains

LS12x-based air-gap measurement chain components	Type	
Air-gap sensor with integral cable *	LS12x	✓
Signal conditioner *	ILS73x	✓
Industrial housing	ABA17x	✓
Multi-wire transmission cable	Kxxx	✓
Power supply **	APFxxx or ASPS	✓
Mechanical diagram (see Figure *x*)		1-6

Notes

* LS120 air-gap sensors must be used with a ILS730 signal conditioner; LS121 air-gap sensors must be used with a ILS731 signal conditioner;

** The power supply current required by a LS12x and ILS73x air-gap measurement chain is too large for the sensor power supply (PS) outputs of VM600^{Mk2} MPC4^{Mk2} and VibroSmart® VSV30x machinery monitoring modules, so an external power supply such as an APFxxx or ASPS is always required.

1.8 Component descriptions

1.8.1 LS12x air-gap sensors

Parker Meggitt's vibro-meter® product line offers a range of LS12x air-gap sensors including:

- LS120 with a linear measurement range of 5 to 30 mm.
- LS121 with a linear measurement range of 20 to 60 mm.

Further information on a specific LS12x air-gap sensor can be found in the corresponding data sheet.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information.

LS12x sensors have an integral cable length of either 5 or 10 m (see 3.2.4 LS12x sensor integral cable) and require a ILS73x signal conditioner.

1.8.2 ILS73x signal conditioners

A LS12x air-gap sensor operates in conjunction with a ILS73x signal conditioner. The signal conditioner excites the air-gap sensor and processes the signals provided by it. It also transforms the signal from a sensor into three voltage-modulated output signals and one current-modulated output signal.

Each LS12x sensor is matched with a ILS73x signal conditioner that has been optimised for operation over its signal range:

- The ILS730 signal conditioner is designed for operation with the LS120 air-gap sensor.
- The ILS731 signal conditioner is designed for operation with the LS121 air-gap sensor.

In addition, each ILS73x signal conditioner is configured for operation with a total system length (TSL) of either 5 m or 10 m, that is, for operation with a LS12x air-gap sensor with an integral cable length of 5 m or 10 m.

NOTE: The choice for the current-modulated output (POLE PROFILE, ROTOR PROFILE or MIN GAP) must be made at the time of ordering.

NOTE: The choice for the total system length (TSL) of 5 m or 10 m must be made at the time of ordering.

ILS73x signal conditioners are factory configured during manufacture and cannot be subsequently modified.

NOTE: The metal housing (electrically conductive) of a ILS73x signal conditioner is connected to its “COM” and “SENSOR SHIELD” signals/terminals. Accordingly, the housing of a ILS73x must be electrically isolated from ground (GND) in order to eliminate earth loops and help ensure the correct operation of the measurement chain.
For further information, see 4.3 Installing a ILS73x signal conditioner and 4.3.1 Mounting procedure.

1.8.3 ABA17x industrial housings

A ABA17x industrial housing can be used to enclose and protect ILS73x signal conditioners. The ABA17x industrial housings are available in different sizes to contain and protect different numbers of signal conditioners. All ABA17x housings offer a protection rating of IP66.

A ABA17x contains one or more DIN rails and a ILS73x is mounted using a MA130 mounting adaptor. The mounting adaptor is made from electrically insulating material to help ensure that earth loops are avoided.

1.8.4 Kxxx transmission cables

A Kxxx transmission cable is used to connect a ILS73x signal conditioner to the electronic monitoring system. These cables are screened multi-wire cables designed for use in harsh industrial environments.

1.8.5 APFxxx power supplies

A APF19x or APF20x power supply is used to power external hardware requiring a 24 V_{DC} power supply, such as a ILS73x (see 1.8.2 ILS73x signal conditioners). A APFxxx requires a mains AC (or high-voltage DC) input and is usually installed on a DIN rail outside the rack, generally in a cubicle housing.

1.8.6 ASPS auxiliary sensor power supply

A ASPS auxiliary sensor power supply can be used to power external hardware requiring a 24 V_{DC} power supply, such as a ILS73x (see 1.8.2 ILS73x signal conditioners).

When a VM600^{Mk2}/VM600 rack is used as the electronic monitoring system, a ASPS can be installed in the rack if an AC input version of the RPS6U rack power supply unit is used. It can replace a APFxxx power supply mounted externally, thereby reducing wiring and simplifying the installation.

1.9 Mechanical diagram

Figure 1-6 shows some examples of the LS12x-based air-gap measurement chains available.

Figure 1-6: Example LS12x-based air-gap measurement chains

2 INSTALLING AIR-GAP SENSORS

This chapter provides general guidelines on mounting and installing Parker Meggitt's air-gap sensors. This information applies to all LS12x air-gap sensors in air-gap measurement chains.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further product specific information.

2.1 General precautions

2.1.1 Equipment installed in potentially explosive atmospheres

STOP

LS12X AIR-GAP SENSORS ARE NOT CERTIFIED FOR AND MUST NOT BE INSTALLED IN POTENTIALLY EXPLOSIVE ATMOSPHERES (HAZARDOUS AREAS / EX ZONES).

NOTE: The procedures described should be strictly followed to ensure that equipment is properly installed.

NOTE: Adhere to general safety procedures, as well as general and specific machine constructor instructions and guidelines. For example, sensors should only be mounted when machines are switched off.

NOTE: Not all mounting and installation options are described in this manual. However, several specific configurations are described in detail and can often be adapted for specific applications. Contact your local Parker Meggitt representative for further information.

2.1.2 Recommended mounting points

Air-gap sensors and their associated hardware must be mounted very carefully in order to improve the quality of data collected and increase product durability. The air-gap measurement chain is used to measure the air gap in electrical generators and must therefore be mounted between the rotor (rotating part) and the stator (stationary part) of the machine. The LS12x sensor must be glued onto the stator iron, that is, the area between the channels containing the stator windings (see Figure 2-1).

Do not screw the sensor to the stator iron.

Use of screws may cause short-circuits between the stator layers. This can cause localised currents of several hundred amperes, leading to the creation of "hot spots" which can destroy the sensor as well as the insulation between stator layers.

The entire sensor must be positioned in the air gap to ensure its measurement field is:

- totally influenced by the passing of the rotor.
- only influenced by the passing of the rotor.

In addition, no metal parts should be placed too close to the sides of the sensor, as this will influence the measurement. If four sensors are used, they should be installed at 90° intervals.

Where possible, the sensor should not be mounted over too many ventilation ducts, that is, the number of covered ducts should be kept to a minimum. The stator iron may overheat if the air flow is inadequate.

Ensure that the stator iron does not overheat because of inadequate ventilation.

Overheating of the stator iron can lead to overheating of the sensor and the adhesive. This can degrade the quality of adhesion (risk of the sensor becoming unstuck) and also the measurement accuracy.

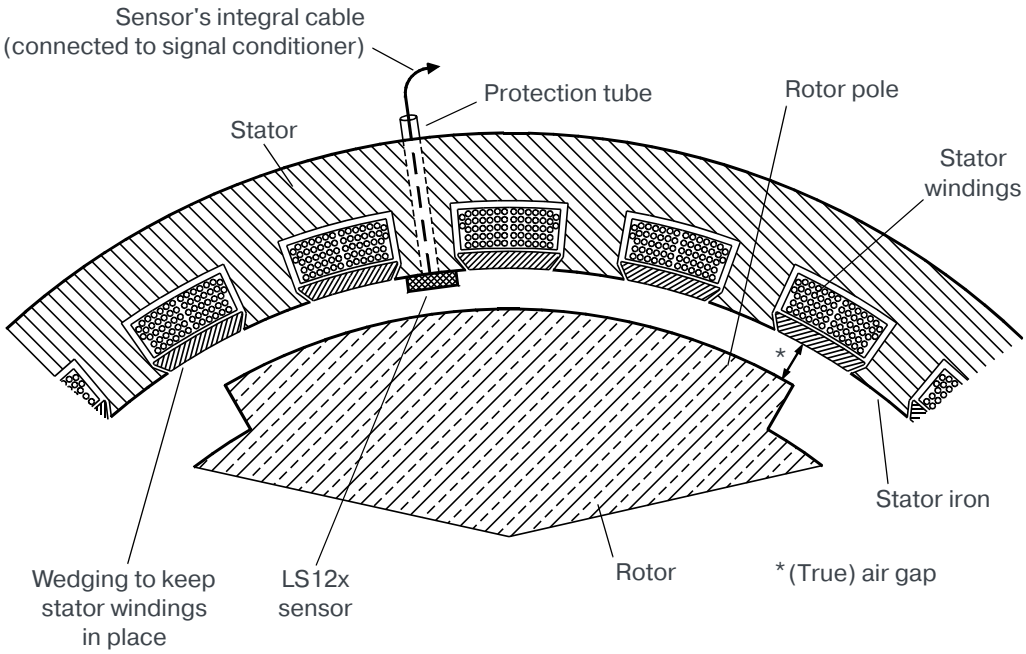

Figure 2-1: Cross-section of an electrical machine showing the sensor mounted on a stator iron

2.1.3 Choice of adhesive

Two types of adhesive are recommended for mounting the sensor: EPO-TEK® T7110 and LOCTITE® 330. The choice of adhesive depends on:

- the temperature expected at the sensor location.
- the type of varnish used to protect the stator.

It is advisable to perform some tests with the adhesives to check their compatibility with the type of varnish used. The correct choice will ensure good long-term adhesion inside the machine.

The main advantage of EPO-TEK T7110 is its increased operating temperature, when compared to LOCTITE 330.

The main advantage of LOCTITE 330 is that it hardens very quickly. The sensor can therefore be mounted by hand instead of having to use supports to hold it in place while the adhesive sets. See 2.2.2.4 Mounting a LS12x sensor with EPO-TEK T7110 adhesive and 2.2.2.5 Mounting a LS12x sensor with LOCTITE 330 adhesive for details of the different mounting procedures. LOCTITE 330 also tolerates rough surfaces (roughness up to 0.4 mm) and it can be stored for up to 1 year before use.

NOTE: Further advice may be obtained from your local Parker Meggitt representative. It will be necessary to provide us with information on the type of varnish used.

2.1.4 Operating temperature range

The ambient temperature where an air-gap sensor is installed must be permanently within its operating temperature range.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information on the operating temperature range of an air-gap sensor.

2.2 Mounting LS12x air-gap sensors

Ideally, the sensor should be mounted when the alternator is being installed or during a machine overhaul.

NOTE: Do not apply paint or varnish to the surface of the sensor once it is installed. The performance of the measurement chain will be affected if this is not respected.

2.2.1 Preparing the machine surface

Before mounting an air-gap sensor, the machine surface should be prepared at the mounting location. If the surface of the stator is not sufficiently smooth and clean, an improvement can normally be obtained by sanding the mounting location with sandpaper.

When sanding, ensure that no short-circuits are created between the metal plates in the stator.

Short circuits will create localised zones where the stator temperature will be higher due to eddy current losses.

Next, clean the mounting location with a clean cotton cloth soaked in isopropyl alcohol (isopropanol or equivalent) to remove any grease and residual dust. Let the isopropyl alcohol evaporate for about an hour before mounting the sensor.

The back of the sensor may also be lightly sanded in a criss-cross (zig-zag) pattern to improve the adhesion of the glue. You should also clean the surface of the sensor with a cotton cloth soaked in acetone, then let the acetone evaporate for about an hour before mounting.

The sensor may now be mounted (see 2.2.2.4 Mounting a LS12x sensor with EPO-TEK T7110 adhesive and 2.2.2.5 Mounting a LS12x sensor with LOCTITE 330 adhesive).

2.2.2 Mounting procedure

The mounting procedure is similar regardless of the variant of air-gap sensor or choice of epoxy glue (adhesive). However, different LS12x air-gap sensors do have different dimensions.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information on the dimensions of an air-gap sensor.

The integral cable should preferably be passed through a ventilation duct (see Figure 2-2, (a) Preferred method). Alternatively, it may be passed between the end windings using a protection tube (see Figure 2-2, (b) Alternative method). In the alternative method, the integral cable must be secured, for example, by using cable clamps glued to the stator iron.

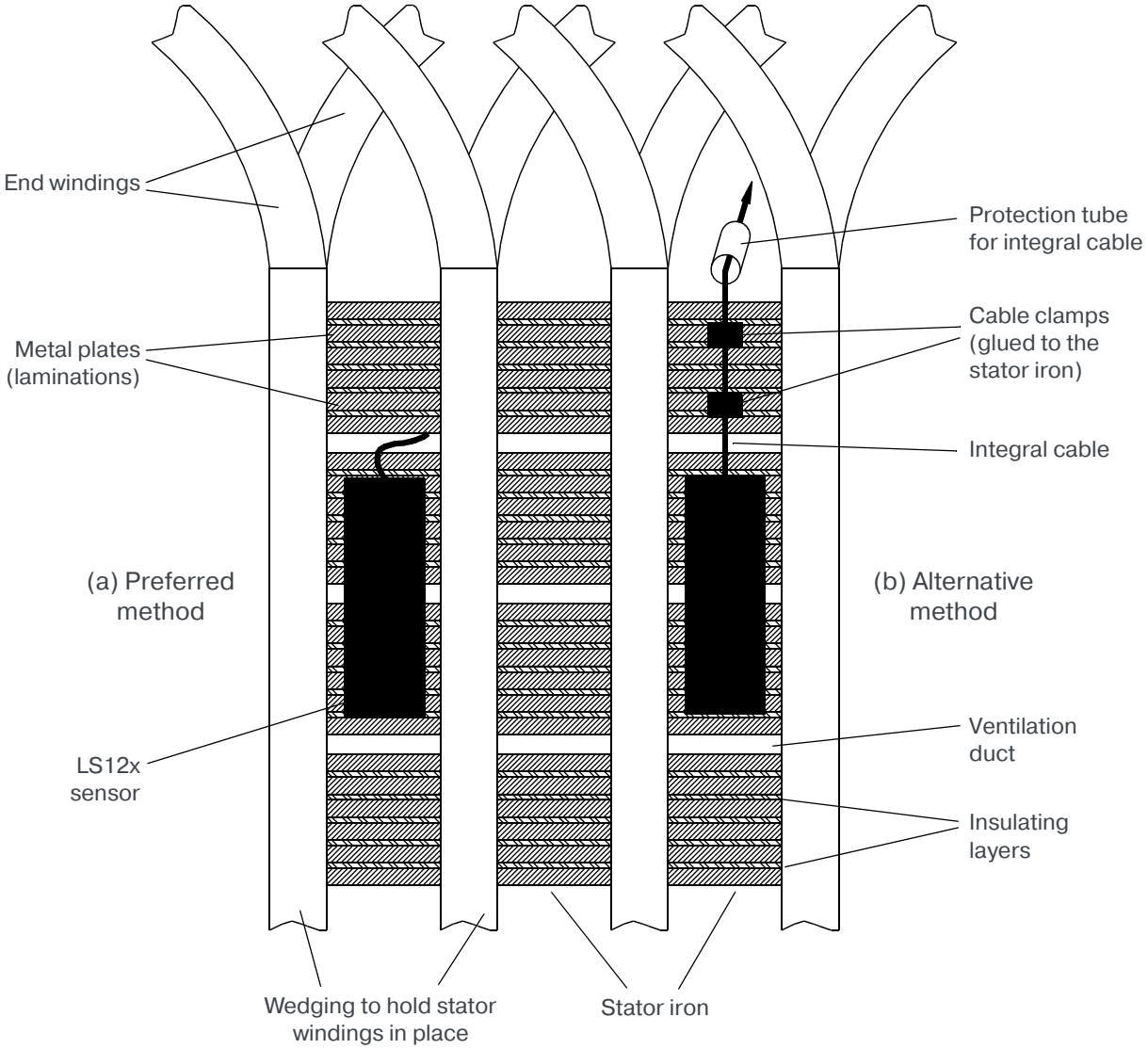

Figure 2-2: Mounting the sensor on the stator iron

2.2.2.1 Required equipment

The following material and equipment is needed for the installation:

- Sandpaper
- Acetone – to clean the sensor and interfaces
- Isopropyl alcohol (isopropanol or equivalent) – to clean the stator
- Clean cotton cloth
- Metal spatula (to mix the adhesive)
- Glass receptacle (for mixing the adhesive)
- EPO-TEK® T7110 adhesive (both components)
  or
  LOCTITE® 330 adhesive and its activator, LOCTITE® 7386
- Precision balance / weighing scales (accurate to ±1 gram)
- Paint brush (to apply the adhesive)
  or
  Paint brush (to apply the activator)
- Rigid metal plate – flat and smooth, at least 10 mm thick and with a larger surface area than the sensor (to ensure uniform pressure when gluing the sensor to the stator)
- Harnessing straps (to apply pressure to the sensor via the metal plate).

The rigid metal plate and harnessing straps are only required if the EPO-TEK adhesive is being used.

An EPO-TEK kit may be ordered directly from your local distributor. This kit contains both components of the EPO-TEK T7110 adhesive, which is typically sufficient for the mounting of up to 16 × LS120 or 8 × LS121 air-gap sensors.

A LOCTITE kit may be ordered directly from Parker Meggitt by quoting the following part number (PNR): 965.06.01.0330. This kit contains a 50 ml tube of LOCTITE 330 and a 18 ml tube of LOCTITE 7386, which is typically sufficient for the mounting of up to 3 × LS120 or 2 × LS121 air-gap sensors.

2.2.2.2 Preparation and cleaning of the sensor

1- Roughen the sensor surface to be glued by sanding it in a criss-cross (zig-zag) manner using sandpaper. This will increase the degree of adhesion.

2- Clean the sensor surface to be glued by wiping it with a clean cotton cloth soaked in acetone. Do not dip the sensor into the acetone.

3- Leave the sensor in a clean place at room temperature for approximately one hour. This allows the acetone to evaporate before proceeding with the gluing.

2.2.2.3 Preparation and cleaning of the stator

1- Smooth the machine surface at the mounting location by sanding it using sandpaper.

2- Prepare the mounting location for gluing by sanding it in a criss-cross (zig-zag) pattern.

3- Clean the mounting location by wiping it with a cotton cloth soaked in isopropyl alcohol (isopropanol or equivalent).

NOTE: Do not use acetone instead of isopropyl alcohol to clean the mounting surface, as acetone can attack certain types of varnish used on stators.

4- Allow the isopropyl alcohol to evaporate at room temperature for approximately one hour before proceeding with the gluing.

2.2.2.4 Mounting a LS12x sensor with EPO-TEK T7110 adhesive

EPO-TEK® T7110 is a two-component adhesive which provides a convenient means of fixing a LS12x sensor to the stator.

When using the EPO-TEK® T7110 adhesive, the continuous operating temperature should not exceed +125°C (+257°F). The sensor may become unstuck if this is not respected.

Please note that depending on the types of varnish and solvents used, a maximum temperature of up to +150°C (+302°F) may be allowed for short periods of time.

To mount the sensor on the stator using EPO-TEK T7110 proceed as follows:

1- Clean the metal spatula and glass receptacle with acetone.

2- Prepare the adhesive mixture in the following proportions by weight:
10 units of Part A to 1 unit of Part B (the hardener component).
Note: Use the precision balance to ensure this is done accurately.

3- Mix the two components together carefully in the glass receptacle using the metal spatula. A homogenous mixture should be obtained. Try to avoid the formation of air bubbles.

NOTE: If the adhesive has been stored for a long time before use (particularly in a cool place), you must warm Part A to approximately 40 to 50°C (104 to 122°F) and stir it well for 3 to 5 minutes.
Then, allow it to cool down to room temperature before adding Part B.
For further information, see “Handling Instructions for EPO-TEK Products” in Appendix A: EPO-TEK T7110 information.

4- Spread the adhesive onto the surface of the sensor using the paint brush or metal spatula. The layer should have a thickness of 0.5 to 1.0 mm and be as even as possible.

5- Position the sensor in place on the previously prepared mounting location of the stator.

6- Apply a uniform force of approximately 100 N (22.48 lb-f) to the sensor, using the rigid metal plate and harnessing straps.

7- Remove the excess adhesive from around the edge of the sensor with a clean cloth.

8- Wait 72 hours at room temperature before removing the rigid metal plate and harnessing straps. You should avoid mechanical or thermal shocks to the sensor during this time.

NOTE: If the waiting time must be reduced:
1. Surround the sensor with a heating cover.
2. Set the heating cover to 60°C (140°F).
3. Leave the heating cover in place for 2 hours, once this temperature has been reached.

NOTE: For more detailed information, see Appendix A: EPO-TEK T7110 information.

Once the LS12x sensor has been mounted in the desired position, its integral cable should be run to the outside of the machine where the cable will be connected to the ILS73x signal conditioner.

2.2.2.5 Mounting a LS12x sensor with LOCTITE 330 adhesive

LOCTITE® 330 and its activator, LOCTITE® 7386, is a two-component adhesive that offers an alternative means of fixing a LS12x sensor to the stator.

When using the LOCTITE® 330 adhesive, the continuous operating temperature should not exceed +80°C (+176°F). The sensor may become unstuck if this is not respected.

Please note that depending on the types of varnish and solvents used, a maximum temperature of up to +100°C (+212°F) may be allowed for short periods of time.

Safety prescriptions for inflammable materials should be respected when installing the sensor.

To mount the sensor on the stator using LOCTITE 330 proceed as follows:

1- Apply the LOCTITE 330 adhesive to the sensor only. It should be applied directly from the tube in a criss-cross (zig-zag) pattern.

2- Apply the LOCTITE 7386 (activator) to the stator only. It should be applied using a small paint brush.

3- Place the sensor in the desired position on the stator.

NOTE: Polymerisation starts as soon as the adhesive and activator are brought into contact. However, it is generally possible to reposition the sensor *slightly* if needed immediately after its initial contact with the stator.

4- Hold the sensor in place on the stator by hand for 3 to 4 minutes. Ensure that the entire surface of the sensor is in contact with the stator. Sufficient pressure should be applied so as to make the layer of adhesive as thin as possible.

5- Approximately 50% of the final strength is reached after 10 to 30 minutes and 100% is reached after 5 hours.

NOTE: For more detailed information, see Appendix B: LOCTITE 330 and LOCTITE 7386 information.

Once the LS12x sensor has been mounted in the desired position, its integral cable should be run to the outside of the machine where the cable will be connected to the ILS73x signal conditioner.

2.2.3 Mounting LS12x air-gap sensors with other adhesives

Araldite® Rapid, a commonly available epoxy adhesive is not recommended as it is not flexible enough.

If Araldite Rapid is used, the sensor may suddenly come unstuck from the stator due to vibrations or mechanical stresses caused by temperature variations.

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3 INSTALLING CABLES

This chapter provides guidelines on installing cables in LS12x-based air-gap measurement chains.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further product specific information.

This information applies to any of the following cables in the chain:

- Integral cables.
- Other transmission cables and connecting cables (Kxxx).

NOTE: The requirements for integral cables are outlined in section 3.2.5 Installation.

3.1 General precautions

3.1.1 Minimum bend radius

It is essential that the minimum bend radius is respected when connecting and fixing an integral cable, extension cable, transmission cable and/or connecting cable.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information on the minimum bend radius of a specific cable.

Failure to respect the minimum bend radius of a cable can lead to permanent cable damage.

3.1.2 Total system length

The combined length of the integral cable and the transmission cable must be one of the appropriate possible total system lengths (TSLs) defined by Parker Meggitt.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information on the total system lengths available for a specific LS12x-based air-gap measurement chain.

Never shorten or lengthen an integral cable or extension cable. The original total system length must be conserved. Otherwise, the calibration of the air-gap measurement chain will become inaccurate.

3.1.3 Operating temperature range

The ambient temperature where a cable is installed must remain permanently within its operating temperature range.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information on the operating temperature range of a cable.

3.1.4 Minimize sources of electromagnetic interference

Signals in a measurement chain are sensitive to electromagnetic interference (EMI) at low frequencies and radio frequency interference (RFI). This is particularly true near the piezoelectric accelerometer, where signal levels are low. Interference can come from a variety of sources including power cables, strong magnetic fields, motors, switching gear, portable phones and walkie-talkies.

The following precautions must be taken to reduce the effects of EMI:

1- Use appropriate grounding techniques. Always conform to the wiring diagrams (see 6 Electrical connections).

2- Electrically isolate (shield) each measurement chain from all others.

3- When possible, place cables in a grounded steel protection tube to provide additional electrical and mechanical protection.

4- Do not run signal cables through conduits used for other purposes such as power cables or communications lines.

3.1.5 Cable conduits

Cable conduits provide mechanical and electrical protection to cables. All signal wiring should be run through conduits that are reserved for only one type of cable. Do not mix signal wiring with power or communications cables.

Cable conduits must be well grounded according to industry standards in order to provide protection against EMI (see 3.1.4 Minimize sources of electromagnetic interference). They should prevent water or other liquids entering. If there is a risk of this happening, or of condensation forming in the conduit, adequate drainage should be provided.

NOTE: Transmission cables (Kxxx) installed after the ILS73x signal conditioner in the measurement chain carry signals that are voltage-based or current-based. These are not as sensitive to the triboelectric effect so clamping is not so vital. Precautions must still be taken to reduce EMI (see 3.1.4 Minimize sources of electromagnetic interference).

3.2 Installing an integral cable

3.2.1 General

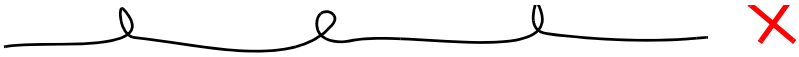
These instructions complement, and replace where necessary, the general instructions given in 3.1 General precautions.

3.2.2 Handling

An integral cable is an important part of the measurement chain. Therefore, integral cables must be handled with care.

The integral cable is delicate and must be handled with care.

Care should be taken when unwinding the cable to prevent the formation of small loops, as follows:



You should carefully unwind ALL of the integral cable before installing the sensor (for example, before feeding the cable through a ventilation duct).

They should not be unnecessarily bent or handled harshly (see 3.2.3 Minimum bend radius).

3.2.3 Minimum bend radius

The minimum bend radius of the integral cable is 10 mm. However, this depends on whether the cable has been bent once or several times at any given point.

The minimum bend radius of a cable must be adhered to at all times or irreversible damage to the cable may result.

Failure to respect this can affect the measurement accuracy of the air-gap measurement chain and prevent its correct operation.

3.2.4 LS12x sensor integral cable

The LS12x sensor's integral cable is available in 5 or 10 m lengths and consists of:

- A transmitter (TRM) coaxial cable (blue).
- A receiver (REC) coaxial cable (blue with yellow marking).
- A sensor shield wire (black).
- A machine ground (GND) wire – 1 m length.

The transmitter (TRM) and receiver (REC) coaxial cables are protected by a common sensor shield wire and FEP insulation (black). There is also a separate machine ground (GND) wire.

Do not attempt to change the length of the integral cable.

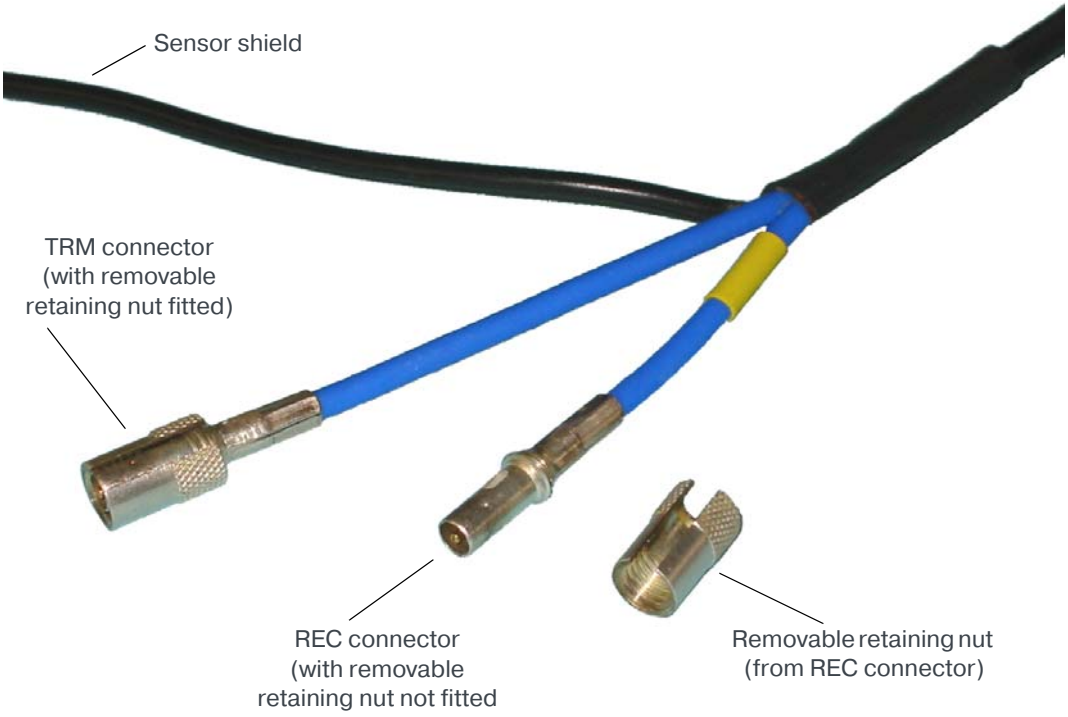
The LS12x sensor, its integral cable and the ILS73x signal conditioner form a calibrated system. Any alteration of cable length (system length must) will degrade the calibration of the air-gap measurement chain.

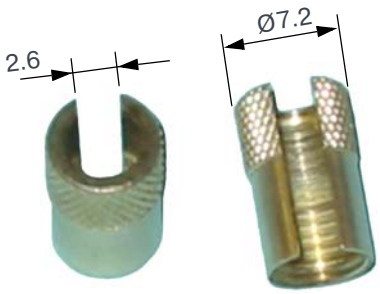
3.2.4.1 Removable retaining nuts

The LS12x sensor's integral cable may have to be fed through one of the small ventilation ducts in an alternator. These typically have dimensions of 6 × 30 mm.

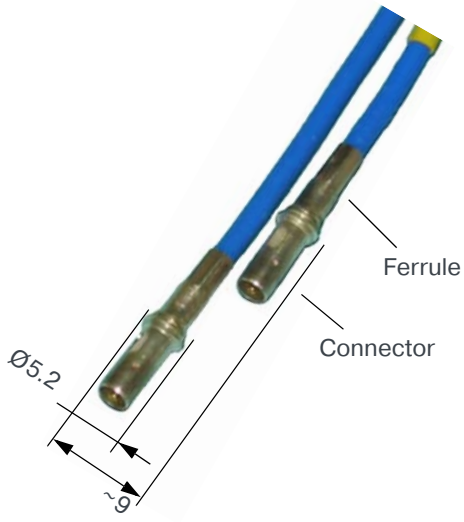
In order to comply with this requirement, the AMP miniature connectors have been equipped with removable retaining nuts (see Figure 3-1). The retaining nuts have each been cut along their length (width of opening is 2.6 mm). They can consequently be easily removed from the Ø2.65 coaxial cables.

The overall dimensions of the sensor cables without their retaining nuts, but with their clamped ferrules and plugs, is approximately 5.2 × 9 mm. This means that once the nuts have been removed, the integral cable assembly can be passed through a ventilation duct. The retaining nuts can then be fitted again.





Enlarged views of
removable retaining nut



Dimensions without the retaining nuts

Figure 3-1: Integral cable connectors with removable retaining nuts

3.2.5 Installation

SEE 3.1 GENERAL PRECAUTIONS BEFORE INSTALLING AN INTEGRAL CABLE.

NOTE: Ensure that the integral sensor cable is long enough for the application before installing a LS12x air-gap sensor.

Using adhesive only, or adhesive in conjunction with cable clamps, it should be possible to lay and attach the cable along the stator iron (see Figure 2-2). Do not try to screw the cable clamps to the stator iron as this may cause short-circuits between the metal plates in the stator.

To run the integral cable out of the stator it is preferable to pass it through one of the stator's ventilation ducts (see Figure 2-2, (a) Preferred method). The connectors have removable retaining nuts to enable this to be done (see 3.2.4.1 Removable retaining nuts).

Alternatively, the cable can be passed through the stator's electrical cable head (see Figure 2-1 and Figure 2-2, (b) Alternative method). If this is done, the cable should be fed through a plastic tube for protection.

In either case, make sure the cable is attached at regular intervals, or preferably glue the cable all along its length. This is necessary to prevent the cable from moving and possibly making contact with the rotor of the machine.

Once the cable is outside the machine it must be fixed by cable clamps and/or glue to the machine housing. Any surplus cable should be coiled up outside the ABA17x industrial housing, with the coil diameter exceeding 300 mm, before the cable end is fed into the housing for connection to the ILS73x signal conditioner.

The sensor ground (GND) wire must be connected directly to the rotating machine ground.

The length of the ground wire should be as short as possible. Its length must not be increased beyond 1 m.

Failure to respect these directives will degrade the performance of the measurement chain.

3.2.5.1 Cable installation procedure

1- Uncoil the integral cable.

2- Clamp and/or glue the cable to the machine surface, ensuring that the minimum bend radius is not exceeded (see 3.2.3 Minimum bend radius).

3- Clamp and/or glue down the entire cable. Any excess cable should be coiled and clamped and/or glued down.

Lengths of cable not properly clamped and/or glued may become damaged, which may lead to irreversible damage to the air-gap sensor and integral cable.

3.3 Installing connecting cables or transmission cables

SEE 3.1 GENERAL PRECAUTIONS BEFORE INSTALLING CONNECTING CABLES OR TRANSMISSION CABLES.

Connecting cables and transmission cables (located after a ILS73x signal conditioner) can be mounted using the standard procedures for low-voltage installations.

4 INSTALLING INDUSTRIAL HOUSINGS AND SIGNAL CONDITIONERS

This chapter provides general guidelines on mounting and installing ABA17x industrial housings and ILS73x signal conditioners in LS12x-based air-gap measurement chains.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further product specific information.

This information applies to the following components in an air-gap measurement chain:

- ABA17x industrial housings (see 4.2 Installing a ABA17x industrial housing).
- ILS73x signal conditioners (see 4.3 Installing a ILS73x signal conditioner).

4.1 General precautions

A ILS73x signal conditioner must be protected by a ABA17x industrial housing, or equivalent. The industrial housing is required to protect the signal conditioner against physical damage, oil and water splashes, dust, and so on.

In the industrial housing, ILS73x signal conditioners must be mounted using MA130 DIN-rail mounting adaptors or insulating plates (non-electrically conductive) in order in order to eliminate earth loops and help ensure the correct operation of the measurement chain.

NOTE: Refer to the industrial housing data sheet for further information on the dimensions and fixing requirements of an industrial housing.

4.1.1 Installation in potentially explosive atmospheres

Although the ABA17x industrial housings are certified for use in potentially explosive atmospheres (hazardous areas), LS12x-based air-gap measurement chains are not appropriately certified and must not be installed in potentially explosive atmospheres.

LS12x-BASED AIR-GAP MEASUREMENT CHAINS ARE NOT CERTIFIED FOR AND MUST NOT BE INSTALLED IN POTENTIALLY EXPLOSIVE ATMOSPHERES (HAZARDOUS AREAS / EX ZONES).

4.1.2 Operating temperature ranges

The temperature where an industrial housing or signal conditioner is installed must be permanently within its operating temperature range.

NOTE: Refer to the industrial housing data sheet for further information on the operating temperature range of an industrial housing.

Only install an industrial housing at a location where the temperature is permanently within the temperature range of the signal conditioner housed within it.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further information on the operating temperature range of a signal conditioner.

4.2 Installing a ABA17x industrial housing

SEE 4.1 GENERAL PRECAUTIONS BEFORE INSTALLING AN INDUSTRIAL HOUSING.

4.2.1 Mounting a ABA17x industrial housing

ABA17x industrial housings have external mounting brackets for easy and safe installation on walls or other mounting surfaces.

1- Choose a vibration-free location to mount the ABA17x industrial housing.

2- Check the distance between the mounting brackets on the industrial housing, then drill and prepare appropriate holes in the mounting surface.

NOTE: Different ABA17x industrial housings do have different dimensions. Further information can be found in the *ABA17x industrial housings data sheet*.

3- Mount the industrial housing on the mounting surface using appropriate screws and fixings such as walls plugs (anchors) for the underlying material.

NOTE: When mounting heavy loads, the screws and fixings used must be suitable for the mounting surface and underlying material.

4- Install the signal conditioner or conditioners and connect the cables within the industrial housing (see 4.3 Installing a ILS73x signal conditioner and 4.3.2 Connecting cables).

4.3 Installing a ILS73x signal conditioner

4.3.1 Mounting procedure

SEE 4.1 GENERAL PRECAUTIONS BEFORE INSTALLING A ILS73X SIGNAL CONDITIONER.

A ILS73x signal conditioner can be installed in different ways:

- ILS73x with MA130 DIN-rail mounting adaptor
  A ILS73x with a DIN-rail mounting adaptor (ordering option code I1) should be installed on a 35 mm wide symmetrical DIN rail such as a TH 35-7.5.
- ILS73x without MA130 DIN-rail mounting adaptor
  A ILS73x without a DIN-rail mounting adaptor (ordering option code I0) should be installed on a base plate or other mounting surface.

A ILS73x is generally mounted in an industrial housing, rack or cabinet/cubicle installed in a vibration-free location.

4.3.1.1 Grounding

NOTE: The metal housing (electrically conductive) of a ILS73x signal conditioner is connected to its “COM” and “SENSOR SHIELD” signals/terminals. Accordingly, a ILS73x must be installed and operated without a direct electrical connection between the ILS73x and ground (GND).

Installation and operation of a ILS73x signal conditioner without a direct electrical connection between the ILS73x and ground (GND) is typically achieved by using a MA130 DIN-rail mounting adaptor to mount the ILS73x on the DIN-rail in a ABA17x industrial housing.

See 6.1 General wiring diagrams.

4.3.1.2 Installing on a DIN rail

A ILS73x signal conditioner with a MA130 DIN-rail mounting adaptor is easily installed on or removed from a DIN rail (see Figure 4-1). No screwdrivers or special tools are required.

To install a ILS73x signal conditioner with a DIN-rail mounting adaptor on a DIN rail:

1- Hook the fixed end of the DIN-rail mounting adaptor onto one edge of the DIN rail.

2- Push against the opposite spring-loaded end of the DIN-rail mounting adaptor (thereby compressing the springs), while pivoting the ILS73x signal conditioner in order to hook this spring-loaded end of the mounting adaptor over the other edge of the DIN rail.

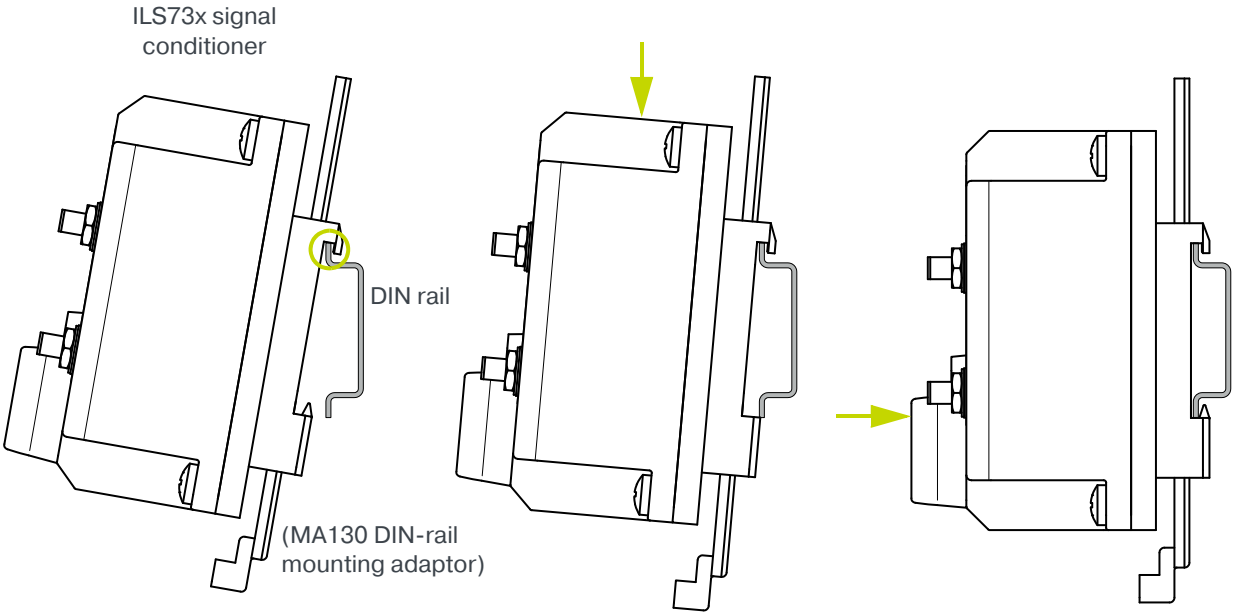
3- Connect the cables to the signal conditioner (see 4.3.2 Connecting cables and 6.1 General wiring diagrams).

Similarly, to remove a ILS73x signal conditioner from a DIN rail:

1- Disconnect the cables to the signal conditioner (see 4.3.2 Connecting cables).

2- Pull the tab of the DIN-rail mounting adaptor away from the body of the ILS73x (thereby compressing the springs), while pivoting the ILS73x signal conditioner in order to unhook the spring-loaded end of the mounting adaptor from one edge of the DIN rail.

3- Unhook the opposite fixed end of the DIN-rail mounting adaptor from the other edge of the DIN rail.



1. Hook the fixed end of the DIN-rail mounting adaptor onto one edge of the DIN rail.

2. Push against the opposite spring-loaded end of the DIN-rail mounting adaptor, while pivoting the ILS73x signal conditioner in order to hook it over the DIN rail.

Figure 4-1: Installing a ABA17x signal conditioner on a DIN rail

4.3.1.3 Installing on a base plate or other mounting surface

To install a ILS73x signal conditioner without a DIN-rail mounting adaptor on a base plate or other mounting surface:

1- Mount the ILS73x signal conditioner on an industrial housing's base plate or other mounting surface using the mounting screws provided.

NOTE: A ILS73x signal conditioner must be mounted on an insulating plate (non-electrically conductive) in order to avoid a direct electrical connection between the ILS73x and ground (GND).

2- Fasten four M4 mounting screws (or equivalent) through the four mounting holes in the body of the ILS73x housing.

3- Connect the cables to the signal conditioner (see 4.3.2 Connecting cables and 6.1 General wiring diagrams).

Similarly, to remove a ILS73x signal conditioner from a base plate or other mounting surface:

1- Disconnect the cables to the ILS73x signal conditioner (see 4.3.2 Connecting cables).

2- Unfasten the four mounting screws.

3- Remove the ILS73x signal conditioner.

4.3.2 Connecting cables

SEE 4.1 GENERAL PRECAUTIONS BEFORE CONNECTING CABLES TO A ILS73X SIGNAL CONDITIONER.

See 4.3.1.1 Grounding for information on grounding and 6.1 General wiring diagrams for detailed wiring diagrams of LS12x-based air-gap measurement chains using a ILS73x signal conditioner.

To connect cables to a ILS73x signal conditioner:

1- Ensure that the power supply to the equipment is turned off.

2- Mount the industrial housing and ILS73x signal conditioner (see 4.2 Installing a ABA17x industrial housing and 4.3 Installing a ILS73x signal conditioner).

3- Strip the insulation from the wires of the integral cable and the transmission cable if required (see 3 Installing cables).

4- Open the door (cover) of the industrial housing.

5- Loosen the cable fittings (stuffing glands) on the industrial housing and feed the cables through.

6- Make the electrical connections within the industrial housing, that is, connect the wires of the sensor cabling to the inputs of the LS12x signal conditioner and the transmission cable to the outputs of the signal conditioner (see 6.1 General wiring diagrams).

7- Tighten the cable fittings (stuffing glands) and check that the cables are securely fastened by the fittings (stuffing glands). This helps ensure that the industrial housing is waterproof.

8- Close the door (or fix the cover) of the industrial housing.

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5 TESTING THE AIR-GAP MEASUREMENT CHAIN

This chapter provides general guidelines on testing the system components in an installed LS12x-based air-gap measurement chain.

NOTE: Refer to the appropriate *LS12x and ILS73x air-gap measurement chain data sheet* for further product specific information.

5.1 On-site test procedure

The air-gap measurement chain (sensor and signal conditioner) can be tested on-site using the procedure provided in this section.

NOTE: It is advisable to check the sensor and signal conditioner before mounting them on the machine. For a more detailed laboratory test procedure, see 5.2 Laboratory test and calibration.

For safety reasons it is recommended to check the air-gap measurement chain when the machine is stopped, particularly if the signal conditioner is mounted inside the machine. If it is not possible to stop the machine to do this, the checks may still be carried out when the machine is running, providing appropriate safety precautions are taken.

IF THE MACHINE IS RUNNING, ENSURE ADEQUATE SAFETY PRECAUTIONS ARE TAKEN BEFORE PERFORMING CHECKS ON THE AIR-GAP MEASUREMENT CHAIN.

THE OPERATOR MAY BE SERIOUSLY INJURED IF THIS DIRECTIVE IS IGNORED.

5.1.1 Required equipment

The following equipment is needed for on-site testing:

- Multimeter (such as DMM) – for LS12x sensor check.
- Oscilloscope – for ILS73x signal conditioner check.

5.1.2 LS12x sensor check

1- Disconnect the +24 V_{DC} power supply from the ILS73x signal conditioner.

2- Disconnect the TRM and REC connectors, and the sensor shield wire from the signal conditioner.

3- Check the insulation and correct connection of the integral sensor wires using the multimeter. The limit values are given in Table 5-1.

4- Reconnect the LS12x sensor coaxial cables (TRM and REC) and the sensor shield wire to the ILS73x signal conditioner.

5- Reconnect the +24 V_{DC} power supply to the signal conditioner.

Table 5-1: LS12x sensor static check values

Conductivity check	
SENSOR SHIELD to GND*	⩽0.1 Ω
TRM shield to GND	⩽0.3 Ω
REC shield to GND	⩽0.2 Ω
TRM shield to REC shield	⩽0.6 Ω
Transmitter check	
TRM wire to TRM shield	75 kΩ ±5 kΩ for the LS120. 10 kΩ to 100 kΩ for the LS121.
Receiver check	
REC wire to REC shield	20 to 500 Ω
REC wire to TRM wire	76 kΩ ±5 kΩ for the LS120. 10 kΩ to 100 kΩ for the LS121.

Notes

* The ground (GND) is defined as the machine ground or the sensor ground wire.

5.1.3 ILS73x signal conditioner check

For this series of checks, the ILS73x signal conditioner should be connected to the LS12x sensor and powered by +24 V_{DC}.

1- Stop the machine.

2- In this condition, the signal conditioner is not synchronised by the signal input and the signal levels in Table 5-2 should be seen.

3- Start the machine.

4- Check the POLE PROFILE signal, using an oscilloscope. This should have a shape similar to the waveform shown in Figure 1-5.

Table 5-2: ILS73x signal conditioner static check values

Signal conditioner check	
POLE PROFILE (0-10V)	Expresses the actual gap value in volts. Use the air-gap calibration curve to convert the observed voltage into a gap (distance) value.
ROTOR PROFILE (0-10V)	>13 V
MIN GAP (0-10V)	>13 V
Current-based output (4 to 20 mA)*	>22 mA

Notes

* The current-based output is factory-set to either POLE PROFILE, ROTOR PROFILE or MIN GAP.

5.2 Laboratory test and calibration

5.2.1 Required equipment

The following material and equipment is needed for the laboratory testing:

- Sensor holder.
- Target plate.
- Set of thickness (distance) gauges.
- +24 V_{DC} power supply.
- Voltmeter or multimeter (such as DMM).

See Figure 5-1 for an example laboratory test setup used for testing an air-gap measurement chain.

5.2.2 Prerequisites

Note the theoretical limits of the measurement range according to 1.4 LS12x sensor types and transfer characteristics:

- 1.875 to 33.125 mm (corresponding to 0 to 10 V) for the LS120 and ILS730.
- 15 to 65 mm (corresponding to 0 to 10V) for the LS121 and ILS731.

Read the notes in 5.2.4 Test and calibration procedure notes.

5.2.3 Test and calibration procedure

The air-gap measurement chain can be tested in a laboratory. The information generated during the test can be used to plot an air-gap calibration curve. The test and calibration procedure (see Figure 5-1) is as follows:

1- Fix the LS12x sensor to the sensor holder. For test purposes, double-sided adhesive tape is sufficient. For long-term mounting, one of the adhesives mentioned in 2.2 Mounting LS12x air-gap sensors should be used.

2- Connect the LS12x sensor coaxial cables (TRM and REC) and the sensor shield wire to the ILS73x signal conditioner.

3- Connect the sensor ground wire to the target plate and also to the sensor holder using a second wire (see note D in 5.2.4 Test and calibration procedure notes).

4- Connect a +24 V_{DC} power supply between the +24V SUPPLY and 0V SUPPLY terminals of the ILS73x signal conditioner.

5- Connect a voltmeter between the POLE PROFILE and COM terminals.

6- Set the sensor target distance to the minimum and maximum values, and to several values in between using a set of gauges, and record the POLE PROFILE voltage at each setting.

7- Plot the distance (x-axis) versus voltage (y-axis) – this is the air-gap calibration curve.

5.2.4 Test and calibration procedure notes

A. The static test procedure is mainly intended for the POLE PROFILE output. More sophisticated test equipment is required to test the ROTOR PROFILE and MIN GAP outputs.

B. In the absence of a target, all outputs are at saturation level:

- 13.5 V ±1.5 V for voltage outputs (load > 1 kΩ).
- 23 mA ±2 mA for the current output (load ⩽ 500 Ω).

C. When the machine is stopped:

- The POLE PROFILE output will reflect the existing gap.
- The ROTOR PROFILE and MIN GAP outputs are at saturation level due to the absence of a triggering signal.

D. In reality, the ground wire will be connected to the stator, which is assumed to be at the same potential as the rotor. This assumption is normally true because:

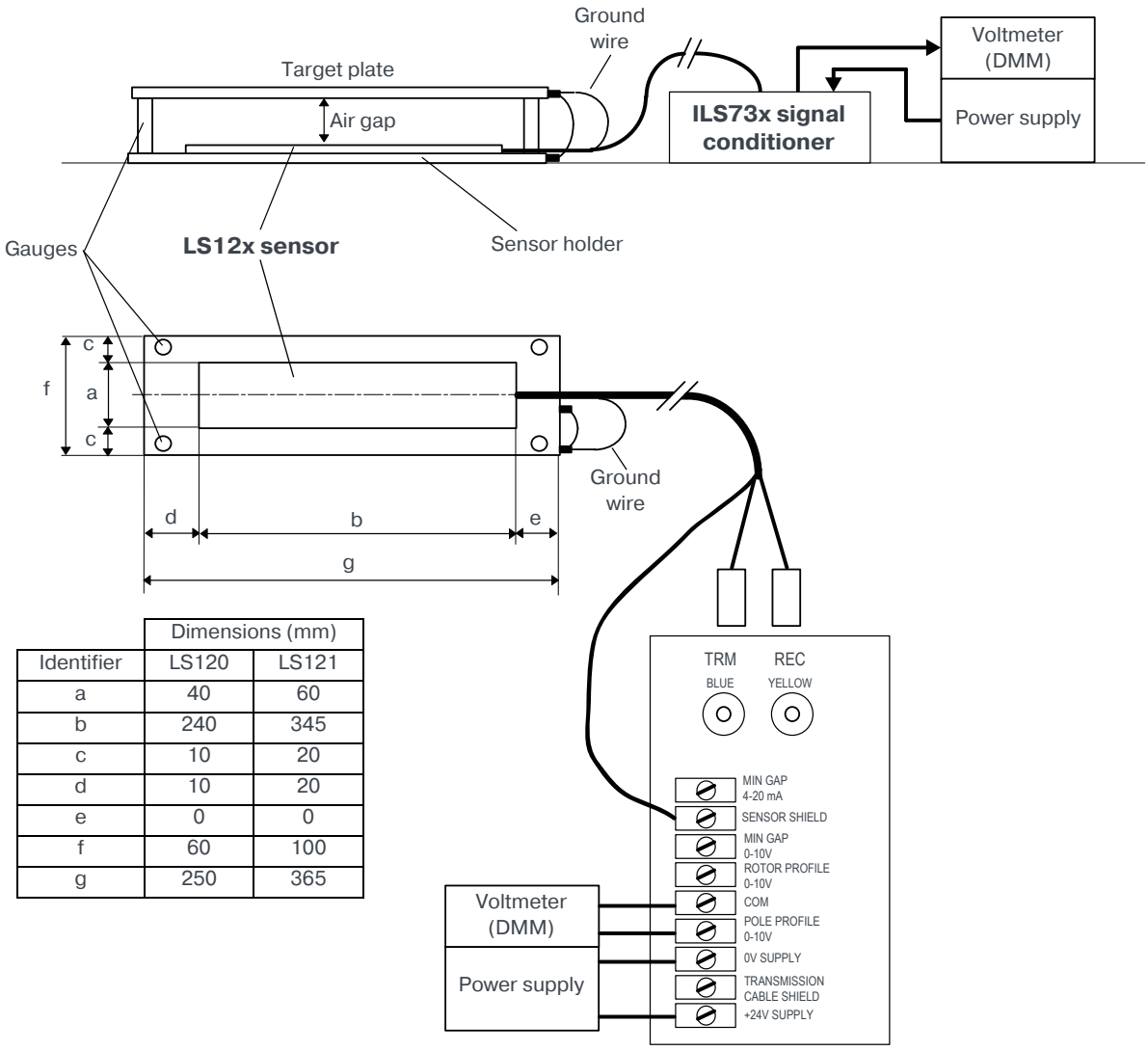
- The good capacitive coupling between the rotor and stator at the bearing surfaces is seen as a short-circuit by the high-frequency measurement chain.
- For hydro-machines, the turbine is in water which is a good earth conductor. The rotating shaft and the rotor are consequently at the same potential as the stator.
- Turbo-machines are normally equipped with a conductive earth brush, ensuring a common stator and rotor potential.

E. The gauges should be placed at a minimum distance from the sensor side of 10 mm for the LS120 and 20 mm for the LS121, or at both sensor extremities. If this is not respected, the measurement will be affected.

5.2.5 Mechanical constraints

In order to minimise measurement errors, the air-gap calibration curve should be plotted while respecting the following conditions:

- The sensor holder and target plate are flat and parallel.
- The sensor holder and target plate are made of a conductive material (for example, steel, aluminium or copper).
- The minimum dimensions of the sensor holder and the target are 60 × 250 mm for the LS120 and 100 × 365 mm for the LS121 (see Figure 5-1).
- The minimum distances from the sensor to the sides of the plates are 10 mm for the LS120 and 20 mm for the LS121.



	Dimensions (mm)	
Identifier	LS120	LS121
a	40	60
b	240	345
c	10	20
d	10	20
e	0	0
f	60	100
g	250	365

Figure 5-1: Testing an air-gap measurement chain

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6 ELECTRICAL CONNECTIONS

6.0.1 General precautions

LS12x AIR-GAP SENSORS ARE NOT CERTIFIED FOR AND MUST NOT BE INSTALLED IN POTENTIALLY EXPLOSIVE ATMOSPHERES (HAZARDOUS AREAS / EX ZONES).

For standard applications in non-hazardous areas (that is, not in potentially explosive atmospheres), no certifications are required for the use of LS12x-based air-gap measurement chains.

6.1 General wiring diagrams

NOTE: Information on connecting equipment to the electronic monitoring system can be found in the project-specific wiring diagram delivered with the system.

Additional information is given in the wiring diagrams listed in Table 6-1.

Table 6-1: Index of wiring diagrams

LS12x-based air-gap measurement chain details	Wiring diagram	Figure
LS12x air-gap sensor with integral cable, ILS73x signal conditioner in a ABAxxx housing and a multi-wire transmission cable. **THIS MEASUREMENT CHAIN MUST NOT BE INSTALLED IN POTENTIALLY EXPLOSIVE ATMOSPHERES.**	051-120-000E011	6-1

The wiring diagram (Figure 6-1) and the wiring instructions (below) should be respected in order to ensure correct operation of LS12x-based air-gap measurement chains and avoid measurement errors.

There are three independent ground references in a LS12x-based air-gap measurement chain:

- The machine ground used as a reference by the LS12x air-gap sensor's transmitter and receiver circuits (MACHINE GROUND).
- The ground used as a reference by the ILS73x signal conditioner's electronic circuitry (COM).
- The ground used by the +24 V_{DC} power supply to the ILS73x signal conditioner (0V SUPPLY).

As shown in Figure 6-1:

- Separate conductors must be used for the electronic circuitry (COM) and +24 V_{DC} power supply (0V SUPPLY) ground wiring between the ILS73x signal conditioner and the machinery monitoring system (for example, via a Kxxx transmission cable).
- The electronic circuitry (COM) and +24 V_{DC} power supply (0V SUPPLY) ground references should be connected together at the machinery monitoring system side (for example, the cubicle or industrial housing with a VM600^{Mk2}/VM600 or VibroSmart®).
- The shield of the transmission cable should also be connected at the machinery monitoring system side only (for example, in the cubicle or industrial housing).

NOTE: If the wiring diagram (Figure 6-1) and the wiring instructions (above) are not respected, the return current in the +24 V_{DC} power supply (0V SUPPLY) wire will introduce a non-negligible voltage drop in the conductor that affects the measurement signal.

For example, given the following parameters:

Power supply current	:	150 mA
Resistance per unit length of conductor (typ.)	:	50 Ω/km
Cable (conductor) length	:	100 m

The following voltage drop would appear in the 24 V_{DC} power supply (0V SUPPLY) ground wire:

Voltage drop = 150 mA × (50 Ω/km × 0.1 km) = 0.75 V

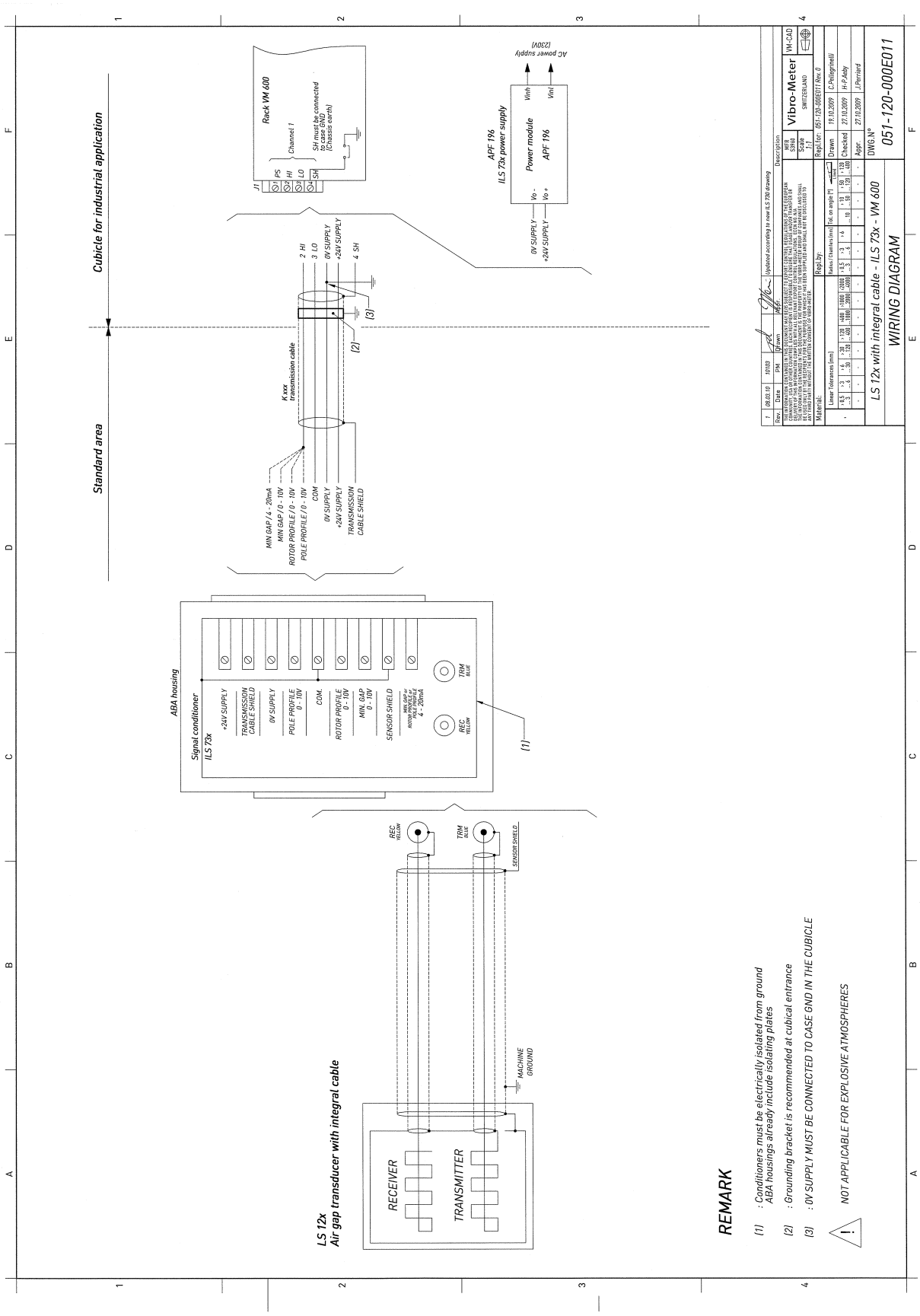

Figure 6-1 : LS12x-based air-gap measurement chain suitable for use in standard applications in non-hazardous areas (that is, not in potentially explosive atmospheres),

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7 MAINTENANCE

7.1 General

No specific maintenance is required for the LS12x-based air-gap measurement chains described in this manual, that is, for LS12x air-gap sensors, cabling or associated equipment such as ILS73x signal conditioners.

However, an initial calibration/configuration of the attached electronic monitoring system is required in order to ensure that true air gap is being considered (see 1.3 Measured air gap and true air gap).

The operation of a LS12x-based air-gap measurement chain can be checked periodically by following the instructions given in 5 Testing the air-gap measurement chain.

NOTE: Any attempt by unauthorised personnel to modify or repair equipment still under guarantee will invalidate the warranty.

See 9 Service and support for the contact details relevant to repairing defective hardware.

7.2 Cleaning

It is not required to clean the components of LS12x-based air-gap measurement chains.

However, if cleaning does become necessary:

- Clean with a damp cloth, then wipe with a dry cloth if required.
- Keep away from live electrical parts.
- Do not use any solvents or cleaning agents. Never pour or spray any cleaner or liquid on the components.

IF CLEANING BECOMES NECESSARY, USE A DAMP CLOTH ONLY AND KEEP AWAY FROM POWERED ('LIVE') ELECTRICAL PARTS.

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8 END-OF-LIFE PRODUCT DISPOSAL

A LS12x-based air-gap measurement chain is an electrical/electronic product, therefore, it must be disposed of in a acceptable manner at the end of its useful life. This is important in order to reduce pollution and improve resource efficiency.

NOTE: For environmental and economic reasons, end-of-life electrical and electronic equipment must be collected and treated separately from other waste: it must not go into landfill (or tip, dump, rubbish dump, garbage dump or dumping ground).

In Europe (the European Union), end-of-life electrical/electronic products are classed as waste electrical and electronic equipment (WEEE), and are subject to the requirements of the European Union (EU) directive 2012/19/EU on waste electrical and electronic equipment (commonly referred to as the WEEE directive).

According to the WEEE regulations, all waste electrical and electronic equipment should be collected separately and then treated and disposed of in accordance with the best available and environmentally friendly techniques. This is because electronic waste (or e-waste) may contain substances harmful to the environment and/or to human health. In addition, electronic waste is also a valuable source of raw materials that can contribute to a circular economy.

The WEEE symbol (a “crossed-out wheeled bin”) is used on product labelling to indicate equipment that must be properly treated and disposed of at the end of its life (see Figure 8-1).

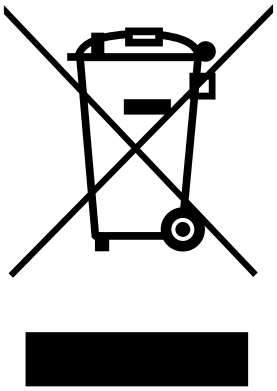

Figure 8-1: WEEE symbol

Although a number of non-EU countries have enacted WEEE regulations, different end-of-life product disposal laws and regulations apply in other countries and regions of the world. Accordingly, please consult your local authorities to obtain the information and guidance relevant to your country and region.

NOTE: At the end of their useful life, electrical/electronic products must be disposed of in an environmentally friendly manner.
In European Union Member States, the WEEE directive is applicable.
In other countries and regions of the world, different laws and regulations may be applicable, so please consult your local authorities.

For additional end-of-life product disposal information and guidance, contact your local Parker Meggitt representative. Alternatively, contact our Swiss (Meggitt SA) office:

Environment, health and safety department
Parker Meggitt (Meggitt SA)
Route de Moncor 4
Case postale
1701 Fribourg
Switzerland

Telephone: +41 26 407 11 11
Email: ehs@ch.meggitt.com
Website: www.meggittsensing.com/energy

9 SERVICE AND SUPPORT

9.1 Contacting us

Parker Meggitt's worldwide customer support network offers a range of support, including 9.2 Technical support and 9.3 Sales and repairs support. For customer support, contact your local Parker Meggitt representative. Alternatively, contact our Swiss (Meggitt SA) office:

Customer support department
Parker Meggitt (Meggitt SA)
Route de Moncor 4
Case postale
1701 Fribourg
Switzerland

Telephone: +41 26 407 11 11
Email: energysupport@ch.meggitt.com
Website: www.meggittsensing.com/energy

9.2 Technical support

Parker Meggitt's technical support team provide both pre-sales and post-sales technical support, including:

- General advice
- Technical advice
- Troubleshooting
- Site visits.

NOTE: For further information, contact your local Parker Meggitt representative (see 9.1 Contacting us).

9.3 Sales and repairs support

Parker Meggitt's sales team provide both pre-sales and post-sales support, including advice on:

- New products
- Spare parts
- Repairs.

NOTE: If a product has to be returned for repairs, then this should be done in accordance with the Energy product return procedure described on page 9-2.

9.4 Customer feedback

As part of our continuing commitment to improving customer service, we welcome your comments. To provide feedback, complete the Energy customer feedback form on page 9-7 and return it to our Swiss (Meggitt SA) office (see 9.1 Contacting us).

REPAIRS AND RETURNS

Energy product return procedure

If a Parker Meggitt (Meggitt SA) energy product needs to be returned to our Swiss (Meggitt SA) office, please use the online product return procedure on the Parker Meggitt website at www.meggittsensing.com/energy/service-and-support/repair

As described on the website, all requests for product repair/return should be sent to Parker Meggitt (Meggitt SA), as follows:

1- Please complete and submit online the Energy product return form that is available on the website.

When the form has been processed by Meggitt, a return merchandise authorization (RMA) document and an end-user certificate (EUC) will be emailed by return, which typically takes a few days.

2- It is optional to issue a PO to Parker Meggitt (Meggitt SA) for every product (may include multiple items / serial numbers).

3- Return the product, together with the signed RMA and EUC, to the address indicated on the RMA.

NOTE: Do NOT send goods back to Parker Meggitt (Meggitt SA) without an RMA form! All goods returned must be accompanied by a fully completed and signed RMA form.

Notes:

- An asterisk (*) in the form below indicates a required field. JavaScript must be enabled (in your web browser) for the form to be displayed and completed correctly.
- For every product to be returned:
  - A separate form must be submitted online. Although multiple items of the same product (one part number, different serial numbers) can be covered by a single form.
  - An associated single-use EUC must be included, unless an annual EUC is in place for your company. Although multiple items of the same product can be covered by a single RMA and EUC.
- When a product is returned, all information is sent to our repair center in our Swiss (Meggitt SA) office. For any queries about product returns, please send an email to energysupport@ch.meggitt.com.
- The RMA document contains a unique reference number that should be used in all communications regarding a product return.

NOTE: The Energy product return form reproduced below is included to support the gathering of information required for completion and submission online.

Energy product return form

Contact information

First name:*

Last name:*

Job title:

Company:*

Address:*

Country:*

Email:*

Telephone:*

Fax:

Product information

Product type:*

Part number (PNR):*

Serial number (SER):

Note: Enter “Unknown” if the serial number (SER) is not known.

Ex product:

☐ Yes

☐ No

SIL product:*

☐ Yes

☐ No

Meggitt SA purchase order number:

Date of purchase (dd.mm.yyyy):

Product under warranty:

☐ Yes

☐ No

☐ Don’t know

Site where installed:

End-user:

Return information

Reason for return:*

☐ Repair

☐ Calibration / recertification

☐ Out-of-box problem

☐ Return

If the reason for return is “Repair”, please answer the following questions:*

Type of problem:

☐ Continuous

☐ Intermittent

☐ Temperature dependent

How long was the operating time before the problem?

Description of problem:

Note: Please provide a detailed description in order to help with problem diagnosis.

If the reason for return is “Out-of-box problem”, please answer the following questions:*

Type of out-of-box problem:

☐ Product damaged

☐ Incorrect product configuration

☐ Incorrect product delivered

☐ Problem with documentation / labelling

☐ Product dead-on-arrival

Additional information:

Note: Please provide as much information as possible in order to help with problem diagnosis.

Ex product information – additional information required for Ex products only

Is the product installed in a hazardous area (potentially explosive atmosphere)?:

☐ Yes

☐ No

If the product is installed in a hazardous area, please answer the following questions:

How long was the operating time before the problem?:

Additional information:

SIL product information – additional information required for SIL products only*

Note: For SIL products used in functional-safety contexts/systems, this SIL product information section must be completed.

When was it installed and first operated (dd.mm.yyyy)?:

When was a proof test last executed (dd.mm.yyyy)?:

Is the product installed in a safety-related system?:*

☐ Yes

☐ No

If the product is installed in a safety-related system, please answer the following questions:*

Did the system fail** in a safe mode?:* (That is, the safety relay operated but the trip was spurious.)

☐ Yes

☐ No

☐ Not applicable

Did the system fail** in a dangerous state?:* (That is, the failure did not result in the safe state.)

☐ Yes

☐ No

☐ Not applicable

How long was the operating time before the failure (in hours)?:*

Additional information:

** A faulty indicator LED is considered as a cosmetic failure.

FEEDBACK

Energy customer feedback form

Manual information

Title of manual:

Air-gap measurement chains using LS12x air-gap sensors with ILS73x signal conditioners installation manual

Reference:	MALS-ILS/E	Version:	Edition 10
Date of issue:	November 2024		

Customer contact information

First name:*

Last name:*

Job title:

Company:*

Address:*

Country:*

Email:*

Telephone:*

Fax:

Feedback – general

Please answer the following questions:

Is the document well organised?	☐ Yes	☐ No
Is the information technically accurate?	☐ Yes	☐ No
Is more technical detail required?	☐ Yes	☐ No
Are the instructions clear and complete?	☐ Yes	☐ No
Are the descriptions easy to understand?	☐ Yes	☐ No
Are the examples and diagrams/photos helpful?	☐ Yes	☐ No
Are there enough examples and diagrams/photos?	☐ Yes	☐ No
Is the style/wording easy to read?	☐ Yes	☐ No
Is any information not included?	☐ Yes	☐ No

Note: Please include any additional information in the “Feedback – additional” section below.

Feedback – additional

Additional information:

Note: Please provide as much feedback as possible in order to help us improve our product documentation.
Continue on a separate sheet if necessary …

APPENDIX A:
EPO-TEK T7110 INFORMATION

This appendix provides safety and technical information on the EPO-TEK® T7110 adhesive recommended for use with the LS12x air-gap sensors.

It contains various technical data sheets and safety data sheets as supplied by the manufacturer of the EPO-TEK T7110 adhesive.

The following documents are included here:

NOTE: To ensure that the latest version of documentation is being used, visit the EPO-TEK® (Epoxy Technology) website at http://www.epotek.com and check for any updates. Alternatively, contact your local Parker Meggitt representative.

Parker MEGGiTT

EPOXY TECHNOLOGY

EPO-TEK® T7110

Technical Data Sheet
For Reference Only
Thermally Conductive, Room-Temperature Cure Epoxy

Date:	July 2019	
Rev:	V	
No. of Components:	Two	
Mix Ratio by Weight:	10 : 1	
Specific Gravity:	Part A: 2.28	Part B: 0.92
Pot Life:	3.5 Hours	
Shelf Life- Bulk:	One year at room temperature	
Shelf Life- Syringe:	Six months at -40°C	

Recommended Cure: 80°C / 2 Hours

Minimum Alternative Cure(s):
May not achieve performance properties listed below
150°C / 10 Minutes
100°C / 1 Hour
23°C / 3 Days

NOTES:
- Container(s) should be kept closed when not in use.
- Filled systems should be stirred thoroughly before mixing and prior to use.
- Performance properties (rheology, conductivity, others) of the product may vary from those stated on the data sheet when bi-pak/syringe packaging or post-processing of any kind is performed. Epoxy's warranties shall not apply to any products that have been reprocessed or repackaged from Epoxy's delivered status/container into any other containers of any kind, including but not limited to syringes, bi-paks, cartridges, pouches, tubes, capsules, films or other packages.
- Syringe packaging will impact initial viscosity and effective pot life, potentially beyond stated parameters.

Product Description: EPO-TEK® T7110 is a two component, thermally conductive, electrically insulating epoxy designed for heat sinking electronics and semiconductors. It may be used as an adhesive, potting, or encapsulation material, for industries such as consumer, medical or optics.

Typical Properties: Cure condition: 80°C / 2 Hours Different batches, conditions & applications yield differing results.
Data below is not guaranteed. To be used as a guide only, not as a specification. * denotes test on lot acceptance basis

PHYSICAL PROPERTIES:		
* Color (before cure):	Part A: Grey	Part B: Clear/Colorless
* Consistency:	Pourable paste	
* Viscosity (23°C) @ 100 rpm:	1,400 - 2,200	cPs
Thixotropic Index:	2.2	
* Glass Transition Temp:	≥ 40	°C (Dynamic Cure: 20-200°C/ISO 25 Min; Ramp -10-200°C @20°C/Min)
Coefficient of Thermal Expansion (CTE):		
Below Tg:	31	x 10^{-6} in/in°C
Above Tg:	142	x 10^{-6} in/in°C
Shore D Hardness:	91	
Lap Shear @ 23°C:	1,932	psi
Die Shear @ 23°C:	≥ 10	Kg 3,556 psi
Degradation Temp:	314	°C
Weight Loss:		
@ 200°C:	0.40	%
@ 250°C:	0.66	%
@ 300°C:	1.78	%
Suggested Operating Temperature:	< 250	°C (Intermittent)
Storage Modulus:	789,250	psi
* Particle Size:	≤ 50	microns

ELECTRICAL AND THERMAL PROPERTIES:		
Thermal Conductivity:	1.0	W/mK
Volume Resistivity @ 23°C:	≥ 2 x 10^{13}	Ohm-cm
Dielectric Constant (1KHz):	5.69	
Dissipation Factor (1KHz):	0.009	

EPOXY TECHNOLOGY, INC.
14 FORTUNE DRIVE, BILLERICA, MA 01821 (978) 667-3805, FAX (978) 663-9782
www.epotek.com

Parker MEGGiTT

EPOXY TECHNOLOGY

EPO-TEK® T7110

Technical Data Sheet
For Reference Only
Thermally Conductive, Room-Temperature Cure Epoxy

EPO-TEK® T7110 Advantages & Suggested Application Notes:

- Low viscosity allows for bubble-free potting and encapsulation.
- Room temperature or low temperature cure (< 100°C) permits use in temperature sensitive devices.
- Suggested Applications:
  - Semiconductor: capillary flow underfill for flip chip mounted die; possible glob top "fill" encapsulant.
  - Electronics: heat sinking; thermally conductive potting and general protection of PCB and SMDs; potting thermistors into cavities; potting and protection of resistor coils or Peltier devices.
  - Hybrids: potting power modules found in electronics such as cockpit, aerospace and Rf/Microwave devices.
  - Optical: encapsulation around copper coils found in nuclear, x-ray, and magnetic imaging; heat sinking outdoor LCD / touch panels exposed to sunlight.
- Low exothermic chemistry during polymerization. This allows up to one liter to be cast or potted in volumes. Contact techserv@epotek.com for the best cure schedule and sample preparation.

EPOXY TECHNOLOGY, INC.
14 FORTUNE DRIVE, BILLERICA, MA 01821 (978) 667-3805, FAX (978) 663-9782
www.epotek.com

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

SAFETY DATA SHEET
EPO-TEK T7110 Part A

1. Identification

Product identifier

Product name EPO-TEK T7110 Part A

Product number T7110/A

Recommended use of the chemical and restrictions on use

Application Adhesive.

Details of the supplier of the safety data sheet

Supplier
Epoxy Technology, Inc.
14 Fortune Drive
Billerica, MA 01821
USA
(978) 667-3805
(978) 663-9782
www.epotek.com, SDS@epotek.com

Emergency telephone number

Emergency telephone +1 (800) 255-3924, +1 (813) 248-0585

2. Hazard(s) identification

Classification of the substance or mixture

Physical hazards Not Classified

Health hazards Skin Irrit. 2 - H315 Eye Dam. 1 - H318 Skin Sens. 1 - H317

Environmental hazards Aquatic Chronic 3 - H412

Label elements

Pictogram

Signal word Danger

Hazard statements
H315 Causes skin irritation.
H317 May cause an allergic skin reaction.
H318 Causes serious eye damage.
H412 Harmful to aquatic life with long lasting effects.

Precautionary statements
P261 Avoid breathing vapor/ spray.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302+P352 If on skin: Wash with plenty of water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P333+P313 If skin irritation or rash occurs: Get medical advice/ attention.
P501 Dispose of contents/ container in accordance with national regulations.

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part A

Contains Bisphenol A Diglycidyl Ether Resin, Reactive Diluent

Other hazards

Hazards not otherwise classified (HNOC) Contains epoxy constituents. May produce an allergic reaction.

3. Composition/information on ingredients

Mixtures

Bisphenol A Diglycidyl Ether Resin CAS number: 25085-99-8	**10-30%**
Classification Skin Irrit. 2 - H315 Eye Irrit. 2 - H319 Skin Sens. 1 - H317 Aquatic Chronic 2 - H411	

Reactive Diluent CAS number: Proprietary	**5-10%**
Classification Acute Tox. 4 - H302 Acute Tox. 4 - H312 Acute Tox. 4 - H332 Skin Irrit. 2 - H315 Eye Dam. 1 - H318 Skin Sens. 1 - H317	

The Full Text for all Hazard Statements are Displayed in Section 16.

4. First-aid measures

Description of first aid measures

Inhalation Move affected person to fresh air at once. Rinse nose and mouth with water. Get medical attention if any discomfort continues.

Ingestion Never give anything by mouth to an unconscious person. Do not induce vomiting. Rinse mouth thoroughly with water. Get medical attention if any discomfort continues.

Skin Contact Remove affected person from source of contamination. Remove contaminated clothing. Wash skin thoroughly with soap and water. Get medical attention if irritation persists after washing.

Eye contact Remove affected person from source of contamination. Remove any contact lenses and open eyelids wide apart. Continue to rinse for at least 15 minutes and get medical attention.

Most important symptoms and effects, both acute and delayed

Inhalation Inhalation of dust during cutting, grinding or sanding operations involving this product may cause irritation of the respiratory tract. Gas or vapor in high concentrations may irritate the respiratory system.

Ingestion May cause discomfort if swallowed.

Skin contact Causes skin irritation. May cause sensitisation by skin contact.

Eye contact Causes serious eye damage.

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part A

Indication of immediate medical attention and special treatment needed

Notes for the doctor	Treat symptomatically.

5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media	Dry chemicals. Foam. Carbon dioxide (CO2).

Special hazards arising from the substance or mixture

Hazardous combustion products	Thermal decomposition or combustion may liberate carbon oxides and other toxic gases or vapors.

Advice for firefighters

Protective actions during firefighting	Avoid breathing fire gases or vapors. Cool containers exposed to heat with water spray and remove them from the fire area if it can be done without risk.
Special protective equipment for firefighters	Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Personal precautions	Wear protective clothing as described in Section 8 of this safety data sheet. Keep unnecessary and unprotected personnel away from the spillage. Avoid contact with skin and eyes.

Environmental precautions

Environmental precautions	Do not discharge into drains or watercourses or onto the ground. Avoid release to the environment.

Methods and material for containment and cleaning up

Methods for cleaning up	Stop leak if possible without risk. Absorb in vermiculite, dry sand or earth and place into containers. Flush contaminated area with plenty of water. Avoid the spillage or runoff entering drains, sewers or watercourses.
Reference to other sections	For personal protection, see Section 8.

7. Handling and storage

Precautions for safe handling

Usage precautions	Handle all packages and containers carefully to minimize spills. Avoid contact with skin and eyes. Wear protective clothing as described in Section 8 of this safety data sheet.
Advice on general occupational hygiene	Provide eyewash station. Do not eat, drink or smoke when using this product. Wash promptly with soap and water if skin becomes contaminated. Wash at the end of each work shift and before eating, smoking and using the toilet. Wash contaminated clothing before reuse. Use appropriate skin cream to prevent drying of skin.

Conditions for safe storage, including any incompatibilities

Storage precautions	Store at room temperature. Keep container tightly sealed when not in use.
Storage class	Chemical storage.

Specific end uses(s)

Specific end use(s)	The identified uses for this product are detailed in Section 1.2.

8. Exposure Controls/personal protection

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part A

Ingredient comments	No exposure limits known for ingredient(s).

Exposure controls

Protective equipment

Appropriate engineering controls	Provide adequate general and local exhaust ventilation.
Eye/face protection	Wear tight-fitting, chemical splash goggles or face shield.
Hand protection	It is recommended that chemical-resistant, impervious gloves are worn.
Other skin and body protection	Wear appropriate clothing to prevent any possibility of skin contact.
Hygiene measures	Do not smoke in work area. Wash hands at the end of each work shift and before eating, smoking and using the toilet. Promptly remove any clothing that becomes contaminated. Use appropriate skin cream to prevent drying of skin. When using do not eat, drink or smoke.
Respiratory protection	If ventilation is inadequate, suitable respiratory protection must be worn.

9. Physical and Chemical Properties

Information on basic physical and chemical properties

Appearance	Paste.
Color	Grey.
Odor	Mild.
Flash point	>93°C
Evaporation rate	<BuAc
Vapor density	>1
Solubility(ies)	Slightly soluble in water.
Other information	None.

10. Stability and reactivity

Reactivity	The following materials may react with the product: Strong oxidizing agents. Strong reducing agents.
Stability	Stable at normal ambient temperatures and when used as recommended.
Possibility of hazardous reactions	Will not polymerize.
Conditions to avoid	Avoid excessive heat for prolonged periods of time.
Materials to avoid	Strong oxidizing agents. Strong reducing agents.
Hazardous decomposition products	Thermal decomposition or combustion products may include the following substances: Carbon monoxide (CO). Carbon dioxide (CO_2).

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part A

11. Toxicological information

Information on toxicological effects

Inhalation	Inhalation of dust during cutting, grinding or sanding operations involving this product may cause irritation of the respiratory tract. Gas or vapor in high concentrations may irritate the respiratory system.
Ingestion	May cause discomfort if swallowed.
Skin Contact	Causes skin irritation. May cause sensitisation by skin contact.
Eye contact	Causes serious eye damage.

12. Ecological Information

Ecotoxicity	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Toxicity

Acute toxicity - fish	Not available.

Persistence and degradability

Persistence and degradability	No data available.

Bioaccumulative potential

Bio-Accumulative Potential	No data available on bioaccumulation.

Mobility in soil

Mobility	No data available.

Other adverse effects

Other adverse effects	Not known.

13. Disposal considerations

Waste treatment methods

Disposal methods	Dispose of waste to licensed waste disposal site in accordance with the requirements of the local Waste Disposal Authority.

14. Transport information

General	The product is not covered by international regulations on the transport of dangerous goods (IMDG, IATA, DoT).

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part A

UN Number

Not applicable.

UN No. (DOT) Not applicable.

UN proper shipping name

Not applicable.

Proper shipping name (DOT) Not applicable.

Transport hazard class(es)

No transport warning sign required.

DOT transport labels

No transport warning sign required.

Packing group

Not applicable.

DOT packing group Not applicable.

Environmental hazards

Environmentally Hazardous Substance

No.

Special precautions for user

Not applicable.

DOT reportable quantity Not applicable.

DOT TIH Zone Not applicable.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

15. Regulatory information

Regulatory References Proprietary information protected pursuant to WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), Section 7, Art. 39.

US Federal Regulations

SARA Section 302 Extremely Hazardous Substances Tier II Threshold Planning Quantities

None of the ingredients are required to be listed.

CERCLA/Superfund, Hazardous Substances/Reportable Quantities (EPA)

None of the ingredients are required to be listed.

SARA Extremely Hazardous Substances EPCRA Reportable Quantities

None of the ingredients are required to be listed.

SARA 313 Emission Reporting

None of the ingredients are required to be listed.

CAA Accidental Release Prevention

None of the ingredients are required to be listed.

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part A

OSHA Highly Hazardous Chemicals
None of the ingredients are required to be listed.

US State Regulations

California Proposition 65 Carcinogens and Reproductive Toxins
None of the ingredients are required to be listed.

California Air Toxics "Hot Spots" (A-I)
None of the ingredients are required to be listed.

California Air Toxics "Hot Spots" (A-II)
None of the ingredients are required to be listed.

Massachusetts "Right To Know" List
None of the ingredients are required to be listed.

Rhode Island "Right To Know" List
None of the ingredients are required to be listed.

Minnesota "Right To Know" List
None of the ingredients are required to be listed.

New Jersey "Right To Know" List
None of the ingredients are required to be listed.

Pennsylvania "Right To Know" List
None of the ingredients are required to be listed.

Inventories

EU - EINECS/ELINCS
Some of the ingredients are listed or exempt.

Canada - DSL/NDSL
All the ingredients are listed or exempt.

US - TSCA
All the ingredients are listed or exempt.

US - TSCA 12(b) Export Notification
None of the ingredients are listed.

Australia - AICS
All the ingredients are listed or exempt.

Japan - MITI
Some of the ingredients are listed or exempt.

Korea - KECI
All the ingredients are listed or exempt.

China - IECSC
All the ingredients are listed or exempt.

Philippines - PICCS
All the ingredients are listed or exempt.

16. Other information

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part A

Revision date	8/29/2016
Revision	2
Supersedes date	6/25/2014
Hazard statements in full	H302 Harmful if swallowed. H312 Harmful in contact with skin. H315 Causes skin irritation. H317 May cause an allergic skin reaction. H318 Causes serious eye damage. H319 Causes serious eye irritation. H332 Harmful if inhaled. H411 Toxic to aquatic life with long lasting effects. H412 Harmful to aquatic life with long lasting effects.

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EPOXY TECHNOLOGY

SAFETY DATA SHEET
EPO-TEK T7110 Part B

1. Identification

Product identifier

Product name EPO-TEK T7110 Part B

Product number T7110/B

Recommended use of the chemical and restrictions on use

Application Adhesive.

Details of the supplier of the safety data sheet

Supplier

Epoxy Technology, Inc.
14 Fortune Drive
Billerica, MA 01821
USA
(978) 667-3805
(978) 663-9782
www.epotek.com, SDS@epotek.com

Emergency telephone number

Emergency telephone +1 (800) 255-3924, +1 (813) 248-0585

2. Hazard(s) identification

Classification of the substance or mixture

Physical hazards Not Classified

Health hazards Acute Tox. 4 - H302 Skin Corr. 1B - H314 Eye Dam. 1 - H318

Environmental hazards Not Classified

Label elements

Pictogram

Signal word Danger

Hazard statements

H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.

Precautionary statements

P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301+P330+P331 If swallowed: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353 If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304+P340 If inhaled: Remove person to fresh air and keep comfortable for breathing.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P501 Dispose of contents/ container in accordance with national regulations.

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part B

Contains Polyoxypropylenediamine

3. Composition/information on ingredients

Mixtures

Polyoxypropylenediamine CAS number: 9046-10-0	**60-100%**
Classification Acute Tox. 4 - H302 Skin Corr. 1B - H314 Eye Dam. 1 - H318	

The Full Text for all Hazard Statements are Displayed in Section 16.

4. First-aid measures

Description of first aid measures

Inhalation Remove affected person from source of contamination. Keep affected person warm and at rest. Get medical attention immediately.

Ingestion Never give anything by mouth to an unconscious person. Do not induce vomiting. Rinse mouth thoroughly with water. Get medical attention immediately.

Skin Contact Remove affected person from source of contamination. Remove contaminated clothing. Wash skin thoroughly with soap and water. Get medical attention promptly if symptoms occur after washing.

Eye contact Remove affected person from source of contamination. Remove any contact lenses and open eyelids wide apart. Continue to rinse for at least 15 minutes. Get medical attention immediately. Continue to rinse.

Most important symptoms and effects, both acute and delayed

Inhalation Gas or vapor in high concentrations may irritate the respiratory system. Inhalation of dust during cutting, grinding or sanding operations involving this product may cause irritation of the respiratory tract.

Ingestion Harmful if swallowed. May cause stomach pain or vomiting. May cause chemical burns in mouth, esophagus and stomach.

Skin contact Burning pain and severe corrosive skin damage.

Eye contact Causes serious eye damage.

Indication of immediate medical attention and special treatment needed

Notes for the doctor Treat symptomatically.

5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media Dry chemicals. Foam. Carbon dioxide (CO2).

Special hazards arising from the substance or mixture

Hazardous combustion products Thermal decomposition or combustion products may include the following substances: Carbon monoxide (CO). Carbon dioxide (CO2). Oxides of nitrogen.

Advice for firefighters

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part B

Protective actions during firefighting	Avoid breathing fire gases or vapors. Cool containers exposed to heat with water spray and remove them from the fire area if it can be done without risk.
Special protective equipment for firefighters	Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Personal precautions	Wear protective clothing as described in Section 8 of this safety data sheet.

Environmental precautions

Environmental precautions	Avoid release to the environment.

Methods and material for containment and cleaning up

Methods for cleaning up	Eliminate all sources of ignition. No smoking, sparks, flames or other sources of ignition near spillage. Provide adequate ventilation. Absorb spillage with sand or other inert absorbent. Wear suitable protective equipment, including gloves, goggles/face shield, respirator, boots, clothing or apron, as appropriate.
Reference to other sections	For personal protection, see Section 8.

7. Handling and storage

Precautions for safe handling

Usage precautions	Avoid contact with skin and eyes. Handle all packages and containers carefully to minimize spills. Wear protective clothing as described in Section 8 of this safety data sheet.
Advice on general occupational hygiene	Provide eyewash station and safety shower. Do not eat, drink or smoke when using this product. Wash promptly with soap and water if skin becomes contaminated. Wash after use and before eating, smoking and using the toilet. Wash contaminated clothing before reuse. Use appropriate skin cream to prevent drying of skin.

Conditions for safe storage, including any incompatibilities

Storage precautions	Store at room temperature. Keep container tightly sealed when not in use.
Storage class	Corrosive storage.

Specific end uses(s)

Specific end use(s)	The identified uses for this product are detailed in Section 1.2.

8. Exposure Controls/personal protection

Ingredient comments	No exposure limits known for ingredient(s).

Exposure controls

Protective equipment

Appropriate engineering controls	Provide adequate general and local exhaust ventilation.
Eye/face protection	Wear tight-fitting, chemical splash goggles or face shield.
Hand protection	It is recommended that chemical-resistant, impervious gloves are worn.

EPO-TEK T7110 Part B

Other skin and body protection	Wear appropriate clothing to prevent any possibility of skin contact.
Hygiene measures	Provide eyewash station and safety shower. Do not smoke in work area. Wash hands at the end of each work shift and before eating, smoking and using the toilet. Promptly remove any clothing that becomes contaminated. Wash promptly with soap and water if skin becomes contaminated. Use appropriate skin cream to prevent drying of skin. When using do not eat, drink or smoke.
Respiratory protection	If ventilation is inadequate, suitable respiratory protection must be worn.

9. Physical and Chemical Properties

Information on basic physical and chemical properties

Appearance	Liquid.
Color	Clear liquid.
Odor	Mild.
Flash point	> 185°C
Evaporation rate	<BuAc
Vapor density	>1
Solubility(ies)	Soluble in water.

10. Stability and reactivity

Reactivity	The following materials may react with the product: Strong oxidizing agents. Strong reducing agents.
Stability	Stable at normal ambient temperatures and when used as recommended.
Possibility of hazardous reactions	Will not polymerize.
Conditions to avoid	Avoid excessive heat for prolonged periods of time.
Materials to avoid	Strong oxidizing agents. Strong reducing agents.
Hazardous decomposition products	Thermal decomposition or combustion products may include the following substances: Carbon monoxide (CO). Carbon dioxide (CO_2). Oxides of nitrogen.

11. Toxicological information

Information on toxicological effects

Inhalation	Gas or vapor in high concentrations may irritate the respiratory system. Inhalation of dust during cutting, grinding or sanding operations involving this product may cause irritation of the respiratory tract.
Ingestion	Harmful if swallowed. May cause stomach pain or vomiting. May cause chemical burns in mouth, esophagus and stomach.
Skin Contact	Causes burns. Harmful in contact with skin.

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part B

Eye contact	Causes burns.

12. Ecological Information

Toxicity

Acute toxicity - fish	Not available.

Persistence and degradability

Persistence and degradability	No data available.

Bioaccumulative potential

Bio-Accumulative Potential	No data available on bioaccumulation.

Mobility in soil

Mobility	No data available.

Other adverse effects

Other adverse effects	Not known.

13. Disposal considerations

Waste treatment methods

Disposal methods	Dispose of waste to licensed waste disposal site in accordance with the requirements of the local Waste Disposal Authority.

14. Transport information

UN Number

UN No. (TDG)	2735
UN No. (IMDG)	2735
UN No. (ICAO)	2735
UN No. (DOT)	UN2735

UN proper shipping name

Proper shipping name (TDG)	AMINES, LIQUID, CORROSIVE, N.O.S. (CONTAINS Polyoxypropylenediamine)
Proper shipping name (IMDG)	AMINES, LIQUID, CORROSIVE, N.O.S. (CONTAINS Polyoxypropylenediamine)
Proper shipping name (ICAO)	AMINES, LIQUID, CORROSIVE, N.O.S. (CONTAINS Polyoxypropylenediamine)
Proper shipping name (DOT)	AMINES, LIQUID, CORROSIVE, N.O.S. (CONTAINS Polyoxypropylenediamine)

Transport hazard class(es)

DOT hazard class	8
DOT hazard label	8
TDG class	8
TDG label(s)	8
IMDG Class	8
ICAO class/division	8

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part B

Transport labels

DOT transport labels

Packing group

TDG Packing Group	III
IMDG packing group	III
ICAO packing group	III
DOT packing group	III

Environmental hazards

Environmentally Hazardous Substance
No.

Special precautions for user

EmS	F-A, S-B
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.

15. Regulatory information

Regulatory References: Proprietary information protected pursuant to WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), Section 7, Art. 39.

US Federal Regulations

SARA Section 302 Extremely Hazardous Substances Tier II Threshold Planning Quantities
None of the ingredients are listed.

CERCLA/Superfund, Hazardous Substances/Reportable Quantities (EPA)
None of the ingredients are listed.

SARA Extremely Hazardous Substances EPCRA Reportable Quantities
None of the ingredients are listed.

SARA 313 Emission Reporting
None of the ingredients are listed.

CAA Accidental Release Prevention
None of the ingredients are listed.

OSHA Highly Hazardous Chemicals
None of the ingredients are listed.

US State Regulations

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part B

California Proposition 65 Carcinogens and Reproductive Toxins
None of the ingredients are listed.

California Air Toxics "Hot Spots" (A-I)
None of the ingredients are listed.

California Air Toxics "Hot Spots" (A-II)
None of the ingredients are listed.

Massachusetts "Right To Know" List
None of the ingredients are listed.

Rhode Island "Right To Know" List
None of the ingredients are listed.

Minnesota "Right To Know" List
None of the ingredients are listed.

New Jersey "Right To Know" List
None of the ingredients are listed.

Pennsylvania "Right To Know" List
None of the ingredients are listed.

Inventories

EU - EINECS/ELINCS
None of the ingredients are listed.

Canada - DSL/NDSL
All the ingredients are listed or exempt.

US - TSCA
All the ingredients are listed or exempt.

US - TSCA 12(b) Export Notification
None of the ingredients are listed.

Australia - AICS
All the ingredients are listed or exempt.

Japan - MITI
All the ingredients are listed or exempt.

Korea - KECI
All the ingredients are listed or exempt.

China - IECSC
All the ingredients are listed or exempt.

Philippines - PICCS
All the ingredients are listed or exempt.

16. Other information

Revision date	8/29/2016
Revision	2

Revision date: 8/29/2016 Revision: 2 Supersedes date: 6/25/2014

EPO-TEK T7110 Part B

Supersedes date	6/25/2014
Hazard statements in full	H302 Harmful if swallowed. H314 Causes severe skin burns and eye damage. H318 Causes serious eye damage.

How to Work Properly with Epoxies

Step By Step Instructions

Receiving

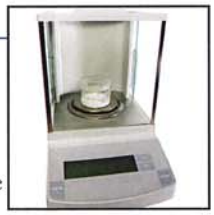
- Upon receipt of the material, review the Technical Data Sheet for specific product information (attached to the packing slip).
- Read and follow the MSDS to insure proper chemical hygiene (safety precautions) of the EPO-TEK material (also attached to packing slip).
- Material shipped in dry ice should **Immediately** be moved to a -40°C freezer upon receipt.

Storing

- Most two component adhesives should be stored at room temperature between (23°C-27°C), in humidity-controlled room (40-60% RH) in a closed container.
- One component materials are typically stored in a freezer at -40°C. The material should always be brought back to room temperature prior to use. **DO NOT** open container until ambient temperature is reached or moisture could condense on the surface and potentially interfere with curing, as well as cause other problems. (see EPO-TEK Tech Tip 2)

Handling

- Epoxies should be handled carefully, in the same manner as other chemical products.
- Work in a well ventilated area or under an exhaust hood. Latex or Nitrile gloves are also required in order to reduce any dermal exposure (dermatitis can usually be avoided by use of proper equipment, safety handling techniques and proper chemical hygiene).
- Gloves should be replaced often and work spaces should be kept clean of contaminants.
- Often, goggles and protective clothing may also be required.
- Wash hands thoroughly with soap and water when finished.



Mixing

- Calculate the amount of A and B needed based on the mix ratio by weight (see Technical Data Sheet for mix ratio and follow exactly). Minimum batch size is 2-3 grams.
- Some products have a maximum batch size limit as well. It is important to read the entire Technical Data Sheet before using the epoxy.
- Using a metal or glass stirrer, mix separately part A, then part B, ensuring each part is homogeneous before weighing the material to be used in the final mixture.
- To measure the correct amount of Part A and Part B, use a gram scale (preferred method). An alternate method is measuring by volume and taking into account the specific gravity of each component (see EPO-TEK Tech Tip 11).
- After taring an empty container, weigh the appropriate amount of part A (pre-determined by your desired end quantity of adhesive).
- Add the pre-determined quantity of part B to the part A. Be sure to use a clean stirrer to avoid contamination.
- Mix slowly 1-2 minute(s) clockwise in a swirling manner, followed by 1-2 minute(s) counter-clockwise, to ensure a homogenous mixture.
- Be careful NOT to vigorously mix the materials as this can introduce entrapped air/bubbles into the adhesive; potentially causing voids in the adhesive bond line.

Special Considerations

- Containers made out of paper or cardboard are NOT recommended as they are often coated and can contaminate the product being mixed.
- Do NOT use wood stir sticks as wood may also contaminate the adhesive.
- Be sure to USE a stainless steel, glass, or a plastic device to mix.

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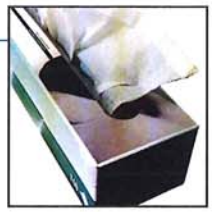
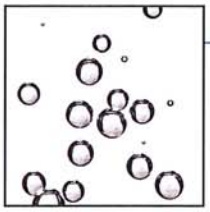
Surface Preparation



- Prepare the bonding surface by applying acetone or isopropyl alcohol to a clean Kim-Wipe® (single use cloth) and wipe the surface until clean.
- Be sure the surface is dry before applying the adhesive.
- For more detailed information on substrate specific surface preparation techniques, see EPO-TEK Tech Tip 13: Surface Preparation.



Bubble Removal (if necessary)

- If an adhesive contains entrapped air, it should be removed in order to apply the epoxy uniformly.
- Three common methods to remove bubbles are: vacuum degassing, centrifugation and heat — depending on your packaging type (syringe or jar container) and application method.
- See EPO-TEK Tech Tip 4: Bubble Removal for specific information on degas methods.

Applying the Epoxy

Depending on your application, some common methods of applying adhesives include:

- syringe dispensing
- screen printing
- spraying
- stamping
- roll coating
- jetting

Proper Curing

- The material should be cured according to the cure condition found above the "Typical Properties" box on the Technical Data Sheet. Often there are alternate cure schedules available. For the minimum cure, see "Minimum Bond Line Cure Schedule" listed at the top right side of the datasheet.
- As a general rule, curing time is typically **extended** in order to ensure the bond line reaches the proper cure temperature.
- See EPO-TEK Tech Tip 6: Minimum Bond Line for additional information.

Additional Tips

✶ Curing time can **never** be too long however, when it is too short, poor cross-linking can result. Shortened cure time often leads to low adhesive strength as well as less than optimal properties.

✶ **General rule of thumb for curing — DOUBLE the recommended cure time listed on the datasheet under minimum bond line cure.**

Please consult our Technical Services Experts at Epoxy Technology for any questions or assistance you may need in working with our EPO-TEK® adhesives.

Contact Information: techserv@epotek.com or 978-667-3805.

EPOXY TECHNOLOGY

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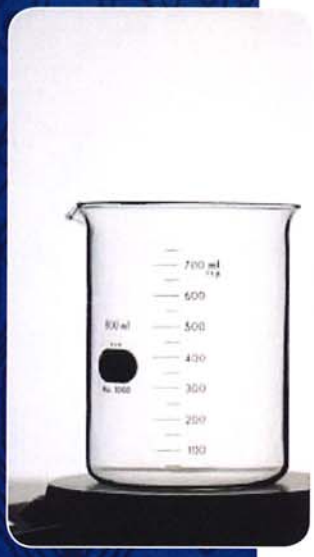
Tech Tip 1

Proper Mixing & Handling of Epoxies

What > Proper Mixing
Why > Mixing and handling epoxies properly eases the application process and increases the chances of achieving a good bond.



Proper mixing and handling epoxies eases the application process and allows for the best possible performance of an adhesive.

For all filled systems, mix contents of each container (part A and part B) before being mixed together. This "premix" re-disperses any filler particles that can sometimes settle. It is also considered good practice to gently mix any one-component systems that contain fillers.

Once the products are thoroughly mixed, weigh out the appropriate amount of each into a third container using a gram scale and the recommended mix ratio found on the data sheet. A minimum of two grams of material should be used each time a product is mixed. This will ensure there is enough material for an adequate cure. Each weighing should remain within +/- 5% of the original ratio for each component. Once the components are weighed out, the product should be mixed for 1-2 minutes in a clockwise fashion and 1-2 minutes in counter-clockwise fashion. This will result in a homogeneous mixture that is ready for application.

Proper storage of the materials is also a key element to material handling. After the weighing of each component is complete, the jar threads should be wiped clean and the caps replaced. If the materials are supplied in the same type of jars, make sure not to mix the caps of the two jars. This could cause cross-contamination and may start to cure or gel any adhesive within the lid threads, causing the jar to seal shut.

Hygiene is also very important when working with epoxies. Most EPO-TEK® epoxies are 100% solids systems, so there is no vapor coming off the material. It is still recommended to work with every material in a well ventilated area or under an exhaust hood. Latex or Nitrile gloves are also required in order to reduce any dermal exposure. Gloves should be replaced often and work spaces should be kept clean of any contaminants. Be sure to wash hands thoroughly with soap and water when finished.

For any necessary clean up of spatulas or counter tops, acetone or IPA (isopropyl alcohol) can be used with a paper towel or rag. Be sure to completely remove all solvent residue in order to avoid any contamination.

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APPENDIX B:
LOCTITE 330 AND LOCTITE 7386 INFORMATION

This appendix provides safety and technical information on the LOCTITE® 330 adhesive and LOCTITE® 7386 activator recommended for use with the LS12x air-gap sensors.

It contains various technical data sheets and material safety data sheets, as supplied by the manufacturer of the LOCTITE adhesives.

The following documents are included here:

NOTE: To ensure that the latest version of documentation is being used, visit the Henkel LOCTITE® website at http://www.henkel-adhesives.com and check for any updates. Alternatively, contact your local Parker Meggitt representative.

Technical Data Sheet

LOCTITE® AA 330™

Known as LOCTITE® 330™
October 2014

PRODUCT DESCRIPTION

LOCTITE® AA 330™ provides the following product characteristics:

Technology	Acrylic
Chemical Type	Urethane methacrylate ester
Appearance (uncured)	Slightly cloudy, colorless to pale yellow liquid[LMS]
Components	One component - requires no mixing
Viscosity	High
Cure	With activator
Application	Bonding

LOCTITE® AA 330™ is a general purpose adhesive that is used to bond metal, wood, ferrite, ceramic and plastic materials. Applications include tool handles, appliances, sporting goods and decorative trim.

NSF International
Registered to NSF Category P1 for use as a sealant where there is no possibilty of food contact in and around food processing areas. **Note:** This is a regional approval. Please contact your local Technical Service Center for more information and clarification.

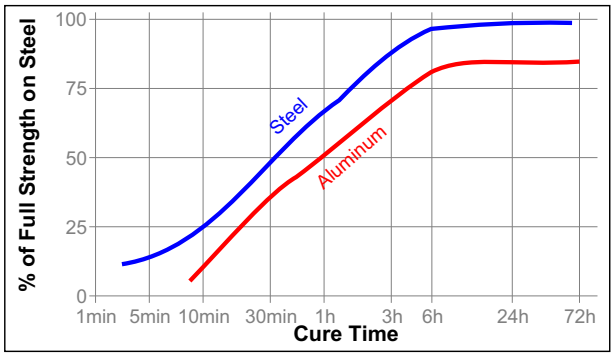
TYPICAL PROPERTIES OF UNCURED MATERIAL

Specific Gravity @ 25 °C	1.05
Viscosity, Brookfield - RVT, 25 °C, mPa·s (cP):	
Spindle 7,, speed 20 rpm,	45,000 to 90,000[LMS]
Viscosity, EN 12092 - SV, 25 °C, after 180 s, mPa·s (cP):	
Shear rate 20 s^{-1}	30,000 to 70,000
Flash Point - See SDS	

TYPICAL CURING PERFORMANCE

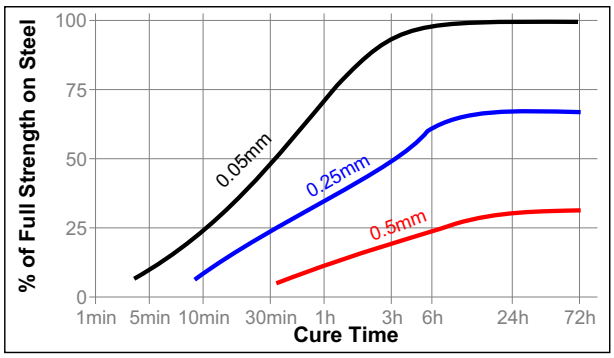
Cure Speed vs. Substrate

The rate of cure will depend on the substrate used. The graph below shows the shear strength developed with time on grit blasted steel lap shears and tested according to ISO 4587. (Activator 7387™ applied to one surface).



Cure Speed vs. Bond Gap

The rate of cure will depend on the bondline gap. The following graph shows the shear strength developed with time on grit blasted steel lap shears at different controlled gaps and tested according to ISO 4587. (Activator 7387™ applied to one surface).



TYPICAL PROPERTIES OF CURED MATERIAL

Physical Properties:

Coefficient of Thermal Expansion, ISO 11359-2, K^{-1}	8×10^{-6}
Coefficient of Thermal Conductivity, ISO 8302, W/(m·K)	0.1
Specific Heat, kJ/(kg·K)	0.3

TYPICAL PERFORMANCE OF CURED MATERIAL

Adhesive Properties

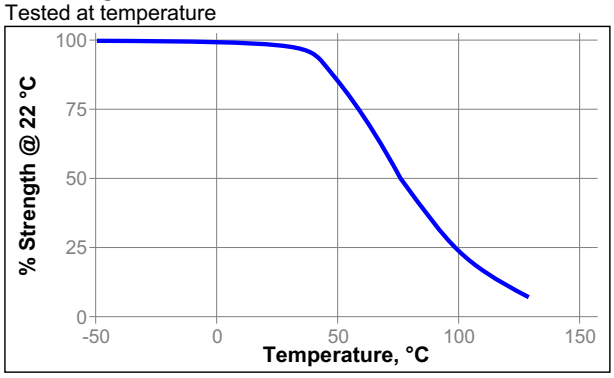
After 24 hours @ 22 °C, Activator 7387™ on 1 side
Lap Shear Strength, ISO 4587:
Mild steel (grit blasted) N/mm² 15 to 30
(psi) (2,175 to 4,350)
Tensile Strength, ISO 6922:
Mild steel (grit blasted) N/mm² 12 to 22
(psi) (1,740 to 3,190)

After 24 hours @ 22 °C, Activator 7387™ or 7386™ on 2 sides
Lap Shear Strength, ISO 4587:
Mild Steel (grit blasted) N/mm² ≥16.5[LMS]
(psi) (≥2,390)

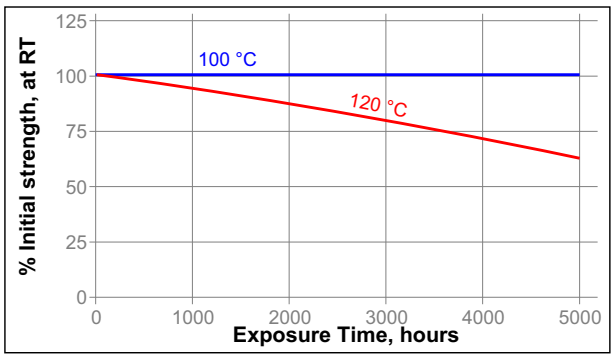
TYPICAL ENVIRONMENTAL RESISTANCE

Cured for 1 week @ 22 °C, Activator 7387™ on 1 side
Lap Shear Strength, ISO 4587:
Mild steel (grit blasted):
0.25 mm gap

Hot Strength
Tested at temperature



Heat Aging
Aged at temperature indicated and tested @ 22 °C



Chemical/Solvent Resistance
Aged under conditions indicated and tested @ 22 °C.

		% of initial strength	
Environment	**°C**	**350 h**	**720 h**
Acetone	22	10	10
Motor oil (MIL-L-46152)	87	90	66
Unleaded gasoline	22	20	20
Phosphate ester	87	93	75
Water/glycol 50/50	87	60	60

GENERAL INFORMATION

This product is not recommended for use in pure oxygen and/or oxygen rich systems and should not be selected as a sealant for chlorine or other strong oxidizing materials.

For safe handling information on this product, consult the Safety Data Sheet (SDS).

Where aqueous washing systems are used to clean the surfaces before bonding, it is important to check for compatibility of the washing solution with the adhesive. In some cases these aqueous washes can affect the cure and performance of the adhesive.

Directions for use:

1. For best performance bond surfaces should be clean and free from grease.
2. To ensure a fast and reliable cure, Activator 7387™ or 7386™ should be applied to one of the bond surfaces and the adhesive to the other surface. Parts should be assembled within 15 minutes.
3. The recommended bondline gap is 0.1 mm. Where bond gaps are large (up to a maximum of 0.5 mm), or faster cure speed is required, Activator 7387™ or 7386™ should be applied to both surfaces. Parts should be assembled immediately (within 1 minute).
4. Excess adhesive can be wiped away with organic solvent.
5. Bond should be held clamped until adhesive has fixtured.
6. Product should be allowed to develop full strength before subjecting to any service loads (typically 24 to 72 hours after assembly, depending on bond gap, materials and ambient conditions).

Loctite Material Specification[LMS]
LMS dated March 11, 1996. Test reports for each batch are available for the indicated properties. LMS test reports include selected QC test parameters considered appropriate to specifications for customer use. Additionally, comprehensive controls are in place to assure product quality and consistency. Special customer specification requirements may be coordinated through Henkel Quality.

Storage
Store product in the unopened container in a dry location. Storage information may be indicated on the product container labeling.
Optimal Storage: 8 °C to 21 °C. Storage below 8 °C or greater than 28 °C can adversely affect product properties
Material removed from containers may be contaminated during use. Do not return product to the original container. Henkel Corporation cannot assume responsibility for product which has been contaminated or stored under conditions other than those previously indicated. If additional information is required, please contact your local Technical Service Center or

Customer Service Representative.

Reference 1.4

Conversions
(°C x 1.8) + 32 = °F
kV/mm x 25.4 = V/mil
mm / 25.4 = inches
µm / 25.4 = mil
N x 0.225 = lb
N/mm x 5.71 = lb/in
N/mm² x 145 = psi
MPa x 145 = psi
N·m x 8.851 = lb·in
N·m x 0.738 = lb·ft
N·mm x 0.142 = oz·in
mPa·s = cP

Note:
The information provided in this Technical Data Sheet (TDS) including the recommendations for use and application of the product are based on our knowledge and experience of the product as at the date of this TDS. The product can have a variety of different applications as well as differing application and working conditions in your environment that are beyond our control. Henkel is, therefore, not liable for the suitability of our product for the production processes and conditions in respect of which you use them, as well as the intended applications and results. We strongly recommend that you carry out your own prior trials to confirm such suitability of our product.
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Henkel

Safety Data Sheet according to Regulation (EC) No 1907/2006

SDS No. : 416828
V008.0

Loctite 330

Revision: 28.12.2018
printing date: 23.05.2019
Replaces version from: 15.01.2018

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier
Loctite 330

1.2. Relevant identified uses of the substance or mixture and uses advised against
Intended use:
Acrylic Adhesive

1.3. Details of the supplier of the safety data sheet
Henkel Ltd
Wood Lane End
HP2 4RQ Hemel Hempstead

Great Britain

Phone: +44 1442 278000
Fax-no.: +44 1442 278071

ua-productsafety.uk@henkel.com

1.4. Emergency telephone number
24 Hours Emergency Tel: +44 (0)1442 278497

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (CLP):

Skin irritation	Category 2
H315 Causes skin irritation.	
Serious eye damage	Category 1
H318 Causes serious eye damage.	
Skin sensitizer	Category 1
H317 May cause an allergic skin reaction.	
Toxic to reproduction	Category 1B
H360D May damage the unborn child.	
Specific target organ toxicity - single exposure	Category 3
H335 May cause respiratory irritation.	
Target organ: respiratory tract irritation	
Chronic hazards to the aquatic environment	Category 3
H412 Harmful to aquatic life with long lasting effects.	

2.2. Label elements

Label elements (CLP):

Hazard pictogram:	
Contains	Tetrahydrofurfuryl methacrylate Methacrylic acid 2-Ethylhexyl methacrylate 1-Methyltrimethylene dimethacrylate reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700)
Signal word:	Danger
Hazard statement:	H315 Causes skin irritation. H318 Causes serious eye damage. H317 May cause an allergic skin reaction. H335 May cause respiratory irritation. H360D May damage the unborn child. H412 Harmful to aquatic life with long lasting effects.
Supplemental information	For use in industrial installations only. Restricted to professional users.
Precautionary statement: Prevention	P201 Obtain special instructions before use. P261 Avoid breathing vapors. P273 Avoid release to the environment. P280 Wear protective gloves/protective clothing/eye protection/face protection.
Precautionary statement: Response	P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P302+P352 IF ON SKIN: Wash with plenty of soap and water. P333+P313 If skin irritation or rash occurs: Get medical advice/attention. P308+P313 IF exposed or concerned: Get medical advice/attention.

2.3. Other hazards

Non corrosive to skin in accordance with the in vitro test method, B40 skin corrosion - Human skin model assay, equivalent to test method OECD 431 or based on analogy to similar products tested.
Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

Declaration of the ingredients according to CLP (EC) No 1272/2008:

Hazardous components CAS-No.	EC Number REACH-Reg No.	content	Classification
Tetrahydrofurfuryl methacrylate 2455-24-5	219-529-5 01-2120748481-53	25- 50 %	Skin Sens. 1 H317 Repr. 1B H360D Aquatic Chronic 3 H412
Methacrylic acid 79-41-4	201-204-4 01-2119463884-26	5- < 10 %	Acute Tox. 4 H302 Acute Tox. 3 H311 Acute Tox. 4 H332 Skin Corr. 1A H314 Eye Dam. 1 H318 STOT SE 3 H335
2-Ethylhexyl methacrylate 688-84-6	211-708-6 01-2119490166-35	5- < 10 %	Skin Sens. 1B H317 STOT SE 3 H335 Skin Irrit. 2 H315 Eye Irrit. 2 H319 Aquatic Chronic 3 H412
1-Methyltrimethylene dimethacrylate 1189-08-8	214-711-0 01-2119969461-31	1- < 5 %	Skin Sens. 1B H317
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	01-2119456619-26	0,1- < 1 %	Skin Irrit. 2 H315 Skin Sens. 1 H317 Eye Irrit. 2 H319 Aquatic Chronic 2 H411
Butyl hydroxytoluene 128-37-0	204-881-4 01-2119565113-46	0,1- < 1 %	Aquatic Acute 1 H400 Aquatic Chronic 1 H410
Cumene hydroperoxide 80-15-9	201-254-7 01-2119475796-19	0,1- < 1 %	Acute Tox. 4; Dermal H312 STOT RE 2 H373 Acute Tox. 4; Oral H302 Org. Perox. E H242 Acute Tox. 3; Inhalation H331 Aquatic Chronic 2 H411 Skin Corr. 1B H314
Tetrahydrofurfuryl alcohol 97-99-4	202-625-6	0,1- < 0,3 %	Eye Irrit. 2 H319 Repr. 1B H360
1,1,2-Trichloroethane 79-00-5	201-166-9	0,1- < 1 %	Carc. 2 H351 Acute Tox. 4; Dermal H312 Acute Tox. 4; Oral H302 Acute Tox. 4; Inhalation H332
Hydroquinone 123-31-9	204-617-8 01-2119524016-51	0,01- < 0,1 %	Aquatic Acute 1 H400 Aquatic Chronic 1

			H410 Carc. 2 H351 Muta. 2 H341 Acute Tox. 4; Oral H302 Eye Dam. 1 H318 Skin Sens. 1 H317 M factor (Acute Aquat Tox): 10

For full text of the H - statements and other abbreviations see section 16 "Other information".
Substances without classification may have community workplace exposure limits available.

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation:
Move to fresh air. If symptoms persist, seek medical advice.

Skin contact:
Rinse with running water and soap.
Obtain medical attention if irritation persists.

Eye contact:
Rinse immediately with plenty of running water (for 10 minutes), seek medical attention from a specialist.

Ingestion:
Rinse mouth, drink 1-2 glasses of water, do not induce vomiting, consult a doctor.

4.2. Most important symptoms and effects, both acute and delayed
SKIN: Redness, inflammation.

RESPIRATORY: Irritation, coughing, shortness of breath, chest tightness.

SKIN: Rash, Urticaria.

After eye contact: Corrosive, may cause permanent damage to eyes (impairment of vision).

May impair fertility.

4.3. Indication of any immediate medical attention and special treatment needed
See section: Description of first aid measures

SECTION 5: Firefighting measures

5.1. Extinguishing media
Suitable extinguishing media:
Carbon dioxide, foam, powder

Extinguishing media which must not be used for safety reasons:
None known

5.2. Special hazards arising from the substance or mixture
In the event of a fire, carbon monoxide (CO), carbon dioxide (CO2) and nitrogen oxides (NOx) can be released.

5.3. Advice for firefighters
Wear self-contained breathing apparatus and full protective clothing, such as turn-out gear.

Additional information:
In case of fire, keep containers cool with water spray.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Ensure adequate ventilation.
Avoid contact with skin and eyes.
Wear protective equipment.

6.2. Environmental precautions
Do not empty into drains / surface water / ground water.

6.3. Methods and material for containment and cleaning up
For small spills wipe up with paper towel and place in container for disposal.
For large spills absorb onto inert absorbent material and place in sealed container for disposal.
Wash spillage site thoroughly with soap and water or detergent solution.
Dispose of contaminated material as waste according to Section 13.

6.4. Reference to other sections
See advice in section 8

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Use only in well-ventilated areas.
Avoid skin and eye contact.
Prolonged or repeated skin contact should be avoided to minimise any risk of sensitisation.
See advice in section 8

Hygiene measures:
Do not eat, drink or smoke while working.
Wash hands before work breaks and after finishing work.
Good industrial hygiene practices should be observed.

7.2. Conditions for safe storage, including any incompatibilities
Refer to Technical Data Sheet

7.3. Specific end use(s)
Acrylic Adhesive

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational Exposure Limits

Valid for
Great Britain

Ingredient [Regulated substance]	ppm	mg/m³	Value type	Short term exposure limit category / Remarks	Regulatory list
Methacrylic acid 79-41-4 [METHACRYLIC ACID]	40	143	Short Term Exposure Limit (STEL):		EH40 WEL
Methacrylic acid 79-41-4 [METHACRYLIC ACID]	20	72	Time Weighted Average (TWA):		EH40 WEL
2,6-di-tert-Butyl-p-cresol 128-37-0 [2,6-DI-TERT-BUTYL-P-CRESOL]		10	Time Weighted Average (TWA):		EH40 WEL
Hydroquinone 123-31-9 [HYDROQUINONE]		0,5	Time Weighted Average (TWA):		EH40 WEL

Occupational Exposure Limits

Valid for
Ireland

Ingredient [Regulated substance]	ppm	mg/m³	Value type	Short term exposure limit category / Remarks	Regulatory list
Methacrylic acid 79-41-4 [METHACRYLIC ACID]	20	70	Time Weighted Average (TWA):		IR_OEL
Methacrylic acid 79-41-4 [METHACRYLIC ACID]	40	140	Short Term Exposure Limit (STEL):		IR_OEL
2,6-di-tert-Butyl-p-cresol 128-37-0 [2,6-DITERTIARY-BUTYL-PARA-CRESOL]		10	Time Weighted Average (TWA):		IR_OEL
1,1,2-Trichloroethane 79-00-5 [1,1,2-TRICHLOROETHANE]	10	45	Time Weighted Average (TWA):		IR_OEL
1,1,2-Trichloroethane 79-00-5 [1,1,2-TRICHLOROETHANE]			Skin designation:	Can be absorbed through the skin.	IR_OEL
Hydroquinone 123-31-9 [HYDROQUINONE]		0,5	Time Weighted Average (TWA):		IR_OEL

Predicted No-Effect Concentration (PNEC):

Name on list	Environmental Compartment	Exposure period	Value				Remarks
			mg/l	ppm	mg/kg	others	
Tetrahydrofurfuryl methacrylate 2455-24-5	aqua (freshwater)		0,347 mg/l				
Tetrahydrofurfuryl methacrylate 2455-24-5	aqua (marine water)		0,035 mg/l				
Tetrahydrofurfuryl methacrylate 2455-24-5	sewage treatment plant (STP)		15,8 mg/l				
Tetrahydrofurfuryl methacrylate 2455-24-5	sediment (freshwater)				2,12 mg/kg		
Tetrahydrofurfuryl methacrylate 2455-24-5	sediment (marine water)				0,212 mg/kg		
Tetrahydrofurfuryl methacrylate 2455-24-5	aqua (intermittent releases)		0,347 mg/l				
Tetrahydrofurfuryl methacrylate 2455-24-5	Soil				0,221 mg/kg		
Methacrylic acid 79-41-4	aqua (freshwater)		0,82 mg/l				
Methacrylic acid 79-41-4	aqua (marine water)		0,82 mg/l				
Methacrylic acid 79-41-4	sewage treatment plant (STP)		10 mg/l				
Methacrylic acid 79-41-4	aqua (intermittent releases)		0,82 mg/l				
Methacrylic acid 79-41-4	Soil				1,2 mg/kg		
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	aqua (freshwater)		0,006 mg/l				
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	aqua (marine water)		0,001 mg/l				
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	sewage treatment plant (STP)		10 mg/l				
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	sediment (freshwater)				0,996 mg/kg		
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	sediment (marine water)				0,1 mg/kg		
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	Soil				0,196 mg/kg		
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	oral				11 mg/kg		
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	aqua (intermittent releases)		0,018 mg/l				
2,6-Di-tert-butyl-p-cresol 128-37-0	aqua (freshwater)		0,000199 mg/l				
2,6-Di-tert-butyl-p-cresol 128-37-0	aqua (marine water)		0,00002 mg/l				
2,6-Di-tert-butyl-p-cresol 128-37-0	sewage treatment plant (STP)		0,17 mg/l				
2,6-Di-tert-butyl-p-cresol 128-37-0	sediment (freshwater)				0,0996 mg/kg		
2,6-Di-tert-butyl-p-cresol	sediment				0,00996		

128-37-0	(marine water)				mg/kg		
2,6-Di-tert-butyl-p-cresol 128-37-0	Soil				0,04769 mg/kg		
2,6-Di-tert-butyl-p-cresol 128-37-0	oral				8,33 mg/kg		
2,6-Di-tert-butyl-p-cresol 128-37-0	aqua (intermittent releases)		0,00199 mg/l				
2,6-Di-tert-butyl-p-cresol 128-37-0	Air						
.alpha.,.alpha.-Dimethylbenzyl hydroperoxide 80-15-9	aqua (freshwater)		0,0031 mg/l				
.alpha.,.alpha.-Dimethylbenzyl hydroperoxide 80-15-9	aqua (marine water)		0,00031 mg/l				
.alpha.,.alpha.-Dimethylbenzyl hydroperoxide 80-15-9	aqua (intermittent releases)		0,031 mg/l				
.alpha.,.alpha.-Dimethylbenzyl hydroperoxide 80-15-9	Sewage treatment plant		0,35 mg/l				
.alpha.,.alpha.-Dimethylbenzyl hydroperoxide 80-15-9	sediment (freshwater)				0,023 mg/kg		
.alpha.,.alpha.-Dimethylbenzyl hydroperoxide 80-15-9	sediment (marine water)				0,0023 mg/kg		
.alpha.,.alpha.-Dimethylbenzyl hydroperoxide 80-15-9	Soil				0,0029 mg/kg		
Tetrahydrofurfuryl alcohol 97-99-4	aqua (freshwater)		1,9 mg/l				
Tetrahydrofurfuryl alcohol 97-99-4	aqua (intermittent releases)		0,917 mg/l				
Tetrahydrofurfuryl alcohol 97-99-4	aqua (marine water)		0,19 mg/l				
Tetrahydrofurfuryl alcohol 97-99-4	sewage treatment plant (STP)		10 mg/l				
Tetrahydrofurfuryl alcohol 97-99-4	sediment (freshwater)				8,6 mg/kg		
Tetrahydrofurfuryl alcohol 97-99-4	sediment (marine water)				0,86 mg/kg		
Tetrahydrofurfuryl alcohol 97-99-4	Soil				0,6 mg/kg		
Hydroquinone 123-31-9	aqua (freshwater)		0,00057 mg/l				
Hydroquinone 123-31-9	aqua (marine water)		0,000057 mg/l				
Hydroquinone 123-31-9	sediment (freshwater)				0,0049 mg/kg		
Hydroquinone 123-31-9	sediment (marine water)				0,00049 mg/kg		
Hydroquinone 123-31-9	aqua (intermittent releases)		0,00134 mg/l				
Hydroquinone 123-31-9	Soil				0,00064 mg/kg		
Hydroquinone 123-31-9	sewage treatment plant (STP)		0,71 mg/l				

Derived No-Effect Level (DNEL):

Name on list	Application Area	Route of Exposure	Health Effect	Exposure Time	Value	Remarks
Tetrahydrofurfuryl methacrylate 2455-24-5	Workers	inhalation	Long term exposure - systemic effects		3,53 mg/m3	
Tetrahydrofurfuryl methacrylate 2455-24-5	Workers	dermal	Long term exposure - systemic effects		1 mg/kg	
Tetrahydrofurfuryl methacrylate 2455-24-5	General population	inhalation	Long term exposure - systemic effects		0,87 mg/m3	
Tetrahydrofurfuryl methacrylate 2455-24-5	General population	dermal	Long term exposure - systemic effects		0,5 mg/kg	
Tetrahydrofurfuryl methacrylate 2455-24-5	General population	oral	Long term exposure - systemic effects		0,5 mg/kg	
Methacrylic acid 79-41-4	Workers	Inhalation	Long term exposure - local effects		88 mg/m3	
Methacrylic acid 79-41-4	Workers	Inhalation	Long term exposure - systemic effects		29,6 mg/m3	
Methacrylic acid 79-41-4	Workers	dermal	Long term exposure - systemic effects		4,25 mg/kg	
Methacrylic acid 79-41-4	General population	Inhalation	Long term exposure - local effects		6,55 mg/m3	
Methacrylic acid 79-41-4	General population	Inhalation	Long term exposure - systemic effects		6,3 mg/m3	
Methacrylic acid 79-41-4	General population	dermal	Long term exposure - systemic effects		2,55 mg/kg	
2-Ethylhexyl methacrylate 688-84-6	worker	dermal	Long term exposure - systemic effects		5 mg/kg	
1-Methyltrimethylene dimethacrylate 1189-08-8	Workers	inhalation	Long term exposure - systemic effects		14,5 mg/m3	
1-Methyltrimethylene dimethacrylate 1189-08-8	Workers	dermal	Long term exposure - systemic effects		4,2 mg/kg	
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	Workers	dermal	Acute/short term exposure - systemic effects		8,33 mg/kg	
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	Workers	Inhalation	Acute/short term exposure - systemic effects		12,25 mg/m3	
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	Workers	dermal	Long term exposure - systemic effects		8,33 mg/kg	
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	Workers	Inhalation	Long term exposure - systemic effects		12,25 mg/m3	
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	General population	dermal	Acute/short term exposure - systemic effects		3,571 mg/kg	
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	General population	dermal	Long term exposure - systemic effects		3,571 mg/kg	
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	General population	oral	Acute/short term exposure - systemic effects		0,75 mg/kg	
Reaction product: bisphenol-A-	General	oral	Long term		0,75 mg/kg	

(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	population		exposure - systemic effects			
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	General population	inhalation	Acute/short term exposure - systemic effects		0,75 mg/m3	
Reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight <= 700) 25068-38-6	General population	inhalation	Long term exposure - systemic effects		0,75 mg/m3	
2,6-Di-tert-butyl-p-cresol 128-37-0	Workers	inhalation	Long term exposure - systemic effects		3,5 mg/m3	
2,6-Di-tert-butyl-p-cresol 128-37-0	Workers	dermal	Long term exposure - systemic effects		0,5 mg/kg	
2,6-Di-tert-butyl-p-cresol 128-37-0	General population	inhalation	Long term exposure - systemic effects		0,86 mg/m3	
2,6-Di-tert-butyl-p-cresol 128-37-0	General population	dermal	Long term exposure - systemic effects		0,25 mg/kg	
2,6-Di-tert-butyl-p-cresol 128-37-0	General population	oral	Long term exposure - systemic effects		0,25 mg/kg	
.alpha.,.alpha.-Dimethylbenzyl hydroperoxide 80-15-9	Workers	inhalation	Long term exposure - systemic effects		6 mg/m3	
Tetrahydrofurfuryl alcohol 97-99-4	Workers	inhalation	Long term exposure - systemic effects		1,4 mg/m3	
Tetrahydrofurfuryl alcohol 97-99-4	Workers	inhalation	Acute/short term exposure - systemic effects		1,4 mg/m3	
Tetrahydrofurfuryl alcohol 97-99-4	Workers	dermal	Long term exposure - systemic effects		0,35 mg/kg	
Tetrahydrofurfuryl alcohol 97-99-4	Workers	dermal	Acute/short term exposure - systemic effects		0,35 mg/kg	
Tetrahydrofurfuryl alcohol 97-99-4	General population	inhalation	Long term exposure - systemic effects		0,25 mg/m3	
Tetrahydrofurfuryl alcohol 97-99-4	General population	inhalation	Acute/short term exposure - systemic effects		0,25 mg/m3	
Tetrahydrofurfuryl alcohol 97-99-4	General population	dermal	Long term exposure - systemic effects		0,175 mg/kg	
Tetrahydrofurfuryl alcohol 97-99-4	General population	dermal	Acute/short term exposure - systemic effects		0,175 mg/kg	
Tetrahydrofurfuryl alcohol 97-99-4	General population	oral	Long term exposure - systemic effects		0,175 mg/kg	
Tetrahydrofurfuryl alcohol 97-99-4	General population	oral	Acute/short term exposure - systemic effects		0,175 mg/kg	
Hydroquinone 123-31-9	Workers	dermal	Long term exposure - systemic effects		3,33 mg/kg	
Hydroquinone 123-31-9	Workers	inhalation	Long term exposure - systemic effects		2,1 mg/m3	
Hydroquinone 123-31-9	General population	dermal	Long term exposure - systemic effects		1,66 mg/kg	
Hydroquinone 123-31-9	General population	inhalation	Long term exposure - systemic effects		1,05 mg/m3	
Hydroquinone 123-31-9	General population	oral	Long term exposure - systemic effects		0,6 mg/kg	

Biological Exposure Indices:
None

8.2. Exposure controls:

Engineering controls:
Ensure good ventilation/extraction.

Respiratory protection:
Ensure adequate ventilation.
An approved mask or respirator fitted with an organic vapour cartridge should be worn if the product is used in a poorly ventilated area
Filter type: A (EN 14387)

Hand protection:
Chemical-resistant protective gloves (EN 374).
Suitable materials for short-term contact or splashes (recommended: at least protection index 2, corresponding to > 30 minutes permeation time as per EN 374):
nitrile rubber (NBR; >= 0.4 mm thickness)
Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374):
nitrile rubber (NBR; >= 0.4 mm thickness)
This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced.

Eye protection:
Safety glasses with sideshields or chemical safety goggles should be worn if there is a risk of splashing.
Protective eye equipment should conform to EN166.

Skin protection:
Wear suitable protective clothing.
Protective clothing should conform to EN 14605 for liquid splashes or to EN 13982 for dusts.

Advices to personal protection equipment:

The information provided on personal protective equipment is for guidance purposes only. A full risk assessment should be conducted prior to using this product to determine the appropriate personal protective equipment to suit local conditions. Personal protective equipment should conform to the relevant EN standard.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	liquid yellow
Odor	Acrylic
Odour threshold	No data available / Not applicable
pH ()	10
Melting point	No data available / Not applicable
Solidification temperature	No data available / Not applicable
Initial boiling point	No data available / Not applicable
Flash point	83 °C (181.4 °F); Tagliabue closed cup
Evaporation rate	No data available / Not applicable
Flammability	No data available / Not applicable
Explosive limits	No data available / Not applicable
Vapour pressure	< 4 mbar
Vapour pressure (50 °C (122 °F))	< 700 mbar
Relative vapour density:	No data available / Not applicable

Density	1,05 g/cm3
()	
Bulk density	No data available / Not applicable
Solubility	No data available / Not applicable
Solubility (qualitative)	Slight
(Solvent: Water)	
Partition coefficient: n-octanol/water	No data available / Not applicable
Auto-ignition temperature	No data available / Not applicable
Decomposition temperature	No data available / Not applicable
Viscosity	No data available / Not applicable
Viscosity (kinematic)	No data available / Not applicable
Explosive properties	No data available / Not applicable
Oxidising properties	No data available / Not applicable

9.2. Other information

No data available / Not applicable

SECTION 10: Stability and reactivity

10.1. Reactivity
Reaction with strong oxidants.

10.2. Chemical stability
Stable under recommended storage conditions.

10.3. Possibility of hazardous reactions
See section reactivity

10.4. Conditions to avoid
Stable under normal conditions of storage and use.

10.5. Incompatible materials
See section reactivity.

10.6. Hazardous decomposition products
carbon oxides.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute oral toxicity:

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Value type	Value	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	LD50	3.945 mg/kg	rat	OECD Guideline 401 (Acute Oral Toxicity)
Methacrylic acid 79-41-4	LD50	1.320 mg/kg	rat	OECD Guideline 401 (Acute Oral Toxicity)
2-Ethylhexyl methacrylate 688-84-6	LD50	> 2.000 mg/kg	rat	OECD Guideline 401 (Acute Oral Toxicity)
1-Methyltrimethylene dimethacrylate 1189-08-8	LD50	> 5.000 mg/kg	rat	not specified
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	LD50	> 2.000 mg/kg	rat	OECD Guideline 420 (Acute Oral Toxicity)
Butyl hydroxytoluene 128-37-0	LD50	> 6.000 mg/kg	rat	OECD Guideline 401 (Acute Oral Toxicity)
Cumene hydroperoxide 80-15-9	LD50	550 mg/kg	rat	not specified
Tetrahydrofurfuryl alcohol 97-99-4	LD50	> 2.000 mg/kg	rat	OECD Guideline 423 (Acute Oral toxicity)
Hydroquinone 123-31-9	LD50	367 mg/kg	rat	OECD Guideline 401 (Acute Oral Toxicity)

Acute dermal toxicity:

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Value type	Value	Species	Method
Methacrylic acid 79-41-4	LD50	500 - 1.000 mg/kg	rabbit	Dermal Toxicity Screening
1-Methyltrimethylene dimethacrylate 1189-08-8	LD50	> 3.000 mg/kg	rabbit	not specified
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	LD50	> 2.000 mg/kg	rat	OECD Guideline 402 (Acute Dermal Toxicity)
Butyl hydroxytoluene 128-37-0	LD50	> 2.000 mg/kg	rat	OECD Guideline 402 (Acute Dermal Toxicity)
Cumene hydroperoxide 80-15-9	LD50	1.200 - 1.520 mg/kg		not specified
Hydroquinone 123-31-9	LD50	> 2.000 mg/kg	rabbit	OECD Guideline 402 (Acute Dermal Toxicity)

Acute inhalative toxicity:

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Value type	Value	Test atmosphere	Exposure time	Species	Method
Methacrylic acid 79-41-4	LC50	> 3,6 mg/l	dust/mist	4 h	rat	OECD Guideline 403 (Acute Inhalation Toxicity)

Skin corrosion/irritation:

Non corrosive to skin in accordance with the in vitro test method, B40 skin corrosion - Human skin model assay, equivalent to test method OECD 431 or based on analogy to similar products tested.

Hazardous substances CAS-No.	Result	Exposure time	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	not irritating	24 h	rabbit	Draize Test
Methacrylic acid 79-41-4	corrosive	3 min	rabbit	OECD Guideline 404 (Acute Dermal Irritation / Corrosion)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	moderately irritating	24 h	rabbit	Draize Test
Butyl hydroxytoluene 128-37-0	not irritating	4 h	rabbit	OECD Guideline 404 (Acute Dermal Irritation / Corrosion)
Cumene hydroperoxide 80-15-9	corrosive		rabbit	Draize Test
Tetrahydrofurfuryl alcohol 97-99-4	not irritating	4 h	rabbit	EPA OPP 81-5 (Acute Dermal Irritation)

Serious eye damage/irritation:

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Result	Exposure time	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	not irritating		rabbit	Draize Test
Methacrylic acid 79-41-4	corrosive		rabbit	Draize Test
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	not irritating		rabbit	OECD Guideline 405 (Acute Eye Irritation / Corrosion)
Butyl hydroxytoluene 128-37-0	slightly irritating		rabbit	OECD Guideline 405 (Acute Eye Irritation / Corrosion)
Tetrahydrofurfuryl alcohol 97-99-4	irritating		rabbit	EPA OPP 81-4 (Acute Eye Irritation)

Respiratory or skin sensitization:

The mixture is classified based on threshold limits referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Result	Test type	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	sensitising	Patch-Test	human	not specified
Tetrahydrofurfuryl methacrylate 2455-24-5	sensitising	Direct peptide reactivity assay (DPRA)	cysteine and lysine, in chemico test	not specified
Methacrylic acid 79-41-4	not sensitising	Buehler test	guinea pig	OECD Guideline 406 (Skin Sensitisation)
2-Ethylhexyl methacrylate 688-84-6	sensitising	Guinea pig maximisation test	guinea pig	Magnusson and Kligman Method
1-Methyltrimethylene dimethacrylate 1189-08-8	sensitising	Mouse local lymphnode assay (LLNA)	mouse	OECD Guideline 429 (Skin Sensitisation: Local Lymph Node Assay)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	sensitising	Mouse local lymphnode assay (LLNA)	mouse	OECD Guideline 429 (Skin Sensitisation: Local Lymph Node Assay)
Butyl hydroxytoluene 128-37-0	not sensitising	Draize Test	guinea pig	Draize Test
Tetrahydrofurfuryl alcohol 97-99-4	not sensitising	Mouse local lymphnode assay (LLNA)	mouse	OECD Guideline 429 (Skin Sensitisation: Local Lymph Node Assay)
Hydroquinone 123-31-9	sensitising	Guinea pig maximisation test	guinea pig	not specified

Germ cell mutagenicity:

The mixture is classified based on threshold limits referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Result	Type of study / Route of administration	Metabolic activation / Exposure time	Species	Method
Methacrylic acid 79-41-4	negative	bacterial reverse mutation assay (e.g Ames test)	with and without		OECD Guideline 471 (Bacterial Reverse Mutation Assay)
2-Ethylhexyl methacrylate 688-84-6	negative	bacterial reverse mutation assay (e.g Ames test)	with and without		OECD Guideline 471 (Bacterial Reverse Mutation Assay)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	negative	bacterial reverse mutation assay (e.g Ames test)	with and without		OECD Guideline 472 (Genetic Toxicology: Escherichia coli, Reverse Mutation Assay)
Butyl hydroxytoluene 128-37-0	negative	bacterial reverse mutation assay (e.g Ames test)	with and without		not specified
Butyl hydroxytoluene 128-37-0	negative	in vitro mammalian chromosome aberration test	with and without		not specified
Butyl hydroxytoluene 128-37-0	negative	mammalian cell gene mutation assay	with		not specified
Cumene hydroperoxide 80-15-9	positive	bacterial reverse mutation assay (e.g Ames test)	without		OECD Guideline 471 (Bacterial Reverse Mutation Assay)
Tetrahydrofurfuryl alcohol 97-99-4	negative	bacterial reverse mutation assay (e.g Ames test)	with and without		OECD Guideline 471 (Bacterial Reverse Mutation Assay)
Tetrahydrofurfuryl alcohol 97-99-4	negative	in vitro mammalian chromosome aberration test	with and without		OECD Guideline 473 (In vitro Mammalian Chromosome Aberration Test)
Tetrahydrofurfuryl alcohol 97-99-4	negative	mammalian cell gene mutation assay	with and without		OECD Guideline 476 (In vitro Mammalian Cell Gene Mutation Test)
Hydroquinone 123-31-9	negative	bacterial reverse mutation assay (e.g Ames test)	with and without		EU Method B.13/14 (Mutagenicity)
Methacrylic acid 79-41-4	negative	inhalation		mouse	OECD Guideline 478 (Genetic Toxicology: Rodent Dominant Lethal Test)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	negative	oral: gavage		mouse	not specified
Butyl hydroxytoluene 128-37-0	negative	oral: feed		rat	not specified
Cumene hydroperoxide 80-15-9	negative	dermal		mouse	not specified

Carcinogenicity

The mixture is classified based on threshold limits referring to the classified substances present in the mixture.

Hazardous components CAS-No.	Result	Route of application	Exposure time / Frequency of treatment	Species	Sex	Method
Methacrylic acid 79-41-4	not carcinogenic	inhalation	2 y	mouse	male/female	OECD Guideline 451 (Carcinogenicity Studies)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	not carcinogenic	dermal	2 y daily	mouse	male	OECD Guideline 453 (Combined Chronic Toxicity / Carcinogenicity Studies)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	not carcinogenic	oral: gavage	2 y daily	rat	male/female	OECD Guideline 453 (Combined Chronic Toxicity / Carcinogenicity Studies)
Butyl hydroxytoluene 128-37-0		oral: feed	2 y daily	rat	male	

Reproductive toxicity:

The mixture is classified based on threshold limits referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Result / Value	Test type	Route of application	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	NOAEL P 300 mg/kg	screening	oral: gavage	rat	OECD Guideline 422 (Combined Repeated Dose Toxicity Study with the Reproduction / Developmental Toxicity Screening Test)
Methacrylic acid 79-41-4	NOAEL P 50 mg/kg NOAEL F1 400 mg/kg NOAEL F2 400 mg/kg	Two generation study	oral: gavage	rat	OECD Guideline 416 (Two-Generation Reproduction Toxicity Study)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	NOAEL P >= 50 mg/kg NOAEL F1 >= 750 mg/kg NOAEL F2 >= 750 mg/kg	Two generation study	oral: gavage	rat	OECD Guideline 416 (Two-Generation Reproduction Toxicity Study)
Butyl hydroxytoluene 128-37-0	NOAEL P 500 mg/kg	Two generation study	oral: feed	rat	not specified

STOT-single exposure:

No data available.

STOT-repeated exposure::

The mixture is classified based on threshold limits referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Result / Value	Route of application	Exposure time / Frequency of treatment	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	NOAEL 300 mg/kg	oral: gavage	29 d yes, concurrent vehicle	rat	OECD Guideline 422 (Combined Repeated Dose Toxicity Study with the Reproduction / Developmental Toxicity Screening Test)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	NOAEL 50 mg/kg	oral: gavage	14 w daily	rat	OECD Guideline 408 (Repeated Dose 90-Day Oral Toxicity in Rodents)
Butyl hydroxytoluene 128-37-0	NOAEL 25 mg/kg	oral: feed	daily	rat	not specified
Cumene hydroperoxide 80-15-9		inhalation: aerosol	6 h/d 5 d/w	rat	not specified
Tetrahydrofurfuryl alcohol 97-99-4	NOAEL 500 ppm	oral: feed	91-93 d daily	rat	not specified
Tetrahydrofurfuryl alcohol 97-99-4	NOAEL 1000 ppm	oral: feed	91-93 d daily	rat	not specified
Hydroquinone 123-31-9	NOAEL >= 250 mg/kg	oral: gavage	14 days 5 days/week. 12 doses	rat	OECD Guideline 407 (Repeated Dose 28-Day Oral Toxicity in Rodents)

Aspiration hazard:

No data available.

SECTION 12: Ecological information

General ecological information:
Do not empty into drains / surface water / ground water.

12.1. Toxicity

Toxicity (Fish):

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Value type	Value	Exposure time	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	LC50	34,7 mg/l	96 h	Pimephales promelas	OECD Guideline 203 (Fish, Acute Toxicity Test)
Methacrylic acid 79-41-4	LC50	85 mg/l	96 h	Salmo gairdneri (new name: Oncorhynchus mykiss)	EPA OTS 797.1400 (Fish Acute Toxicity Test)
2-Ethylhexyl methacrylate 688-84-6	LC50	2,78 mg/l	96 h	Oryzias latipes	OECD Guideline 203 (Fish, Acute Toxicity Test)
1-Methyltrimethylene dimethacrylate 1189-08-8	LC50	32,5 mg/l	48 h		DIN 38412-15
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	LC50	1,75 mg/l	96 h	Oncorhynchus mykiss	OECD Guideline 203 (Fish, Acute Toxicity Test)
Butyl hydroxytoluene 128-37-0	LC50		96 h	Brachydanio rerio (new name: Danio rerio)	EU Method C.1 (Acute Toxicity for Fish)
Butyl hydroxytoluene 128-37-0	NOEC	0,053 mg/l	30 d	Oryzias latipes	OECD Guideline 210 (fish early lite stage toxicity test)
Cumene hydroperoxide 80-15-9	LC50	3,9 mg/l	96 h	Oncorhynchus mykiss	OECD Guideline 203 (Fish, Acute Toxicity Test)
Tetrahydrofurfuryl alcohol 97-99-4	LC50	> 101 mg/l	96 h	Oryzias latipes	OECD Guideline 203 (Fish, Acute Toxicity Test)
1,1,2-Trichloroethane 79-00-5	LC50	136 mg/l	96 h	Pimephales promelas	OECD Guideline 203 (Fish, Acute Toxicity Test)
Hydroquinone 123-31-9	LC50	0,638 mg/l	96 h	Oncorhynchus mykiss	OECD Guideline 203 (Fish, Acute Toxicity Test)

Toxicity (Daphnia):

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Value type	Value	Exposure time	Species	Method
Methacrylic acid 79-41-4	EC50	> 130 mg/l	48 h	Daphnia magna	EPA OTS 797.1300 (Aquatic Invertebrate Acute Toxicity Test, Freshwater Daphnids)
2-Ethylhexyl methacrylate 688-84-6	EC50	4,56 mg/l	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	EC50	1,7 mg/l	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
Butyl hydroxytoluene 128-37-0	EC50	0,48 mg/l	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
Cumene hydroperoxide 80-15-9	EC50	18 mg/l	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
1,1,2-Trichloroethane 79-00-5	EC50	160 mg/l	48 h	Daphnia magna	other guideline:
Hydroquinone 123-31-9	EC50	0,134 mg/l	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)

Chronic toxicity to aquatic invertebrates

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Value type	Value	Exposure time	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	NOEC	37,2 mg/l	21 d	Daphnia magna	OECD 211 (Daphnia magna, Reproduction Test)
2-Ethylhexyl methacrylate 688-84-6	NOEC	0,105 mg/l	21 d	Daphnia magna	OECD 211 (Daphnia magna, Reproduction Test)
1-Methyltrimethylene dimethacrylate 1189-08-8	NOEC	5,09 mg/l	21 d	Daphnia magna	OECD 211 (Daphnia magna, Reproduction Test)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	NOEC	0,3 mg/l	21 d	Daphnia magna	OECD 211 (Daphnia magna, Reproduction Test)
Butyl hydroxytoluene 128-37-0	NOEC	0,069 mg/l	21 d	Daphnia magna	OECD 211 (Daphnia magna, Reproduction Test)
Hydroquinone 123-31-9	NOEC	0,0057 mg/l	21 d	Daphnia magna	OECD 211 (Daphnia magna, Reproduction Test)

Toxicity (Algae):

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Value type	Value	Exposure time	Species	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	EC50	> 100 mg/l	72 h	Desmodesmus subspicatus	OECD Guideline 201 (Alga, Growth Inhibition Test)
Tetrahydrofurfuryl methacrylate 2455-24-5	NOEC	> 100 mg/l	72 h	Desmodesmus subspicatus	OECD Guideline 201 (Alga, Growth Inhibition Test)
Methacrylic acid 79-41-4	NOEC	8,2 mg/l	72 h	Selenastrum capricornutum (new name: Pseudokirchneriella subcapitata)	OECD Guideline 201 (Alga, Growth Inhibition Test)
Methacrylic acid 79-41-4	EC50	45 mg/l	72 h	Selenastrum capricornutum (new name: Pseudokirchneriella subcapitata)	OECD Guideline 201 (Alga, Growth Inhibition Test)
2-Ethylhexyl methacrylate 688-84-6	EC50	7,68 mg/l	72 h	Pseudokirchneriella subcapitata	OECD Guideline 201 (Alga, Growth Inhibition Test)
2-Ethylhexyl methacrylate 688-84-6	NOEC	0,28 mg/l	72 h	Pseudokirchneriella subcapitata	OECD Guideline 201 (Alga, Growth Inhibition Test)
1-Methyltrimethylene dimethacrylate 1189-08-8	EC50	9,79 mg/l	72 h	Desmodesmus subspicatus	OECD Guideline 201 (Alga, Growth Inhibition Test)
1-Methyltrimethylene dimethacrylate 1189-08-8	NOEC	2,11 mg/l	72 h	Desmodesmus subspicatus	OECD Guideline 201 (Alga, Growth Inhibition Test)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	EC50	> 11 mg/l	72 h	Scenedesmus capricornutum	OECD Guideline 201 (Alga, Growth Inhibition Test)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	NOEC	4,2 mg/l	72 h	Scenedesmus capricornutum	OECD Guideline 201 (Alga, Growth Inhibition Test)
Butyl hydroxytoluene 128-37-0	EC50		72 h	Desmodesmus subspicatus (reported as Scenedesmus subspicatus)	EU Method C.3 (Algal Inhibition test)
Butyl hydroxytoluene 128-37-0	EC10	0,4 mg/l	72 h	Desmodesmus subspicatus (reported as Scenedesmus subspicatus)	EU Method C.3 (Algal Inhibition test)
Cumene hydroperoxide 80-15-9	ErC50	3,1 mg/l	72 h	Pseudokirchneriella subcapitata	OECD Guideline 201 (Alga, Growth Inhibition Test)
1,1,2-Trichloroethane 79-00-5	EC50	213 mg/l	72 h	Scenedesmus subspicatus (new name: Desmodesmus subspicatus)	OECD Guideline 201 (Alga, Growth Inhibition Test)
Hydroquinone 123-31-9	EC50	0,335 mg/l	72 h	Selenastrum capricornutum (new name: Pseudokirchneriella subcapitata)	OECD Guideline 201 (Alga, Growth Inhibition Test)

Toxicity to microorganisms

The mixture is classified based on calculation method referring to the classified substances present in the mixture.

Hazardous substances CAS-No.	Value type	Value	Exposure time	Species	Method
Methacrylic acid 79-41-4	EC10	100 mg/l	17 h		not specified
1-Methyltrimethylene dimethacrylate 1189-08-8	NOEC	20 mg/l	28 d	activated sludge, domestic	not specified
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	IC50	> 100 mg/l	3 h	activated sludge, industrial	other guideline:
Butyl hydroxytoluene 128-37-0	EC50		3 h	activated sludge	OECD Guideline 209 (Activated Sludge, Respiration Inhibition Test)
Cumene hydroperoxide 80-15-9	EC10	70 mg/l	30 min		not specified
Hydroquinone 123-31-9	EC 50	0,038 mg/l	30 min		not specified

12.2. Persistence and degradability

The product is not biodegradable.

Hazardous substances CAS-No.	Result	Test type	Degradability	Exposure time	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	not readily biodegradable.	aerobic	75 %	28 d	OECD Guideline 301 F (Ready Biodegradability: Manometric Respirometry Test)
Methacrylic acid 79-41-4	inherently biodegradable	aerobic	100 %	14 d	OECD Guideline 302 B (Inherent biodegradability: Zahn-Wellens/EMPA Test)
Methacrylic acid 79-41-4	readily biodegradable	aerobic	86 %	28 d	OECD Guideline 301 D (Ready Biodegradability: Closed Bottle Test)
2-Ethylhexyl methacrylate 688-84-6	readily biodegradable	aerobic	88 %	28 d	OECD Guideline 301 C (Ready Biodegradability: Modified MITI Test (I))
1-Methyltrimethylene dimethacrylate 1189-08-8	readily biodegradable	aerobic	84 %	28 d	OECD Guideline 310 (Ready BiodegradabilityCO2 in Sealed Vessels (Headspace Test)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	not readily biodegradable.	aerobic	5 %	28 d	OECD Guideline 301 F (Ready Biodegradability: Manometric Respirometry Test)
Butyl hydroxytoluene 128-37-0	not readily biodegradable.	aerobic	4,5 %	28 d	OECD Guideline 301 C (Ready Biodegradability: Modified MITI Test (I))
Butyl hydroxytoluene 128-37-0	not inherently biodegradable	aerobic	5,2 - 5,6 %	35 d	OECD Guideline 302 C (Inherent Biodegradability: Modified MITI Test (II))
Cumene hydroperoxide 80-15-9		no data	0 %	28 d	OECD Guideline 301 B (Ready Biodegradability: CO2 Evolution Test)
Tetrahydrofurfuryl alcohol 97-99-4	readily biodegradable	aerobic	92 %	28 d	OECD Guideline 301 C (Ready Biodegradability: Modified MITI Test (I))
1,1,2-Trichloroethane 79-00-5	not readily biodegradable.	aerobic	5 %	28 day	OECD Guideline 301 C (Ready Biodegradability: Modified MITI Test (I))
Hydroquinone 123-31-9	readily biodegradable	aerobic	75 - 81 %	30 d	EU Method C.4-E (Determination of the "Ready" BiodegradabilityClosed Bottle Test)

12.3. Bioaccumulative potential

No data available for the product.

Hazardous substances CAS-No.	Bioconcentration factor (BCF)	Exposure time	Temperature	Species	Method
2-Ethylhexyl methacrylate 688-84-6	37	56 h	24 °C	Danio rerio	OECD Guideline 305 (Bioconcentration: Flow-through Fish Test)
Butyl hydroxytoluene 128-37-0	330 - 1.800	56 d		Cyprinus carpio	OECD Guideline 305 C (Bioaccumulation: Test for the Degree of Bioconcentration in Fish)
Cumene hydroperoxide 80-15-9	9,1			calculation	OECD Guideline 305 (Bioconcentration: Flow-through Fish Test)
1,1,2-Trichloroethane 79-00-5	2	14 d		Lepomis macrochirus	other guideline:

12.4. Mobility in soil

Cured adhesives are immobile.

Hazardous substances CAS-No.	LogPow	Temperature	Method
Tetrahydrofurfuryl methacrylate 2455-24-5	1,76		EU Method A.8 (Partition Coefficient)
Methacrylic acid 79-41-4	0,93	22 °C	OECD Guideline 107 (Partition Coefficient (n-octanol / water), Shake Flask Method)
2-Ethylhexyl methacrylate 688-84-6	4,95	20 °C	OECD Guideline 107 (Partition Coefficient (n-octanol / water), Shake Flask Method)
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	3,242	25 °C	EU Method A.8 (Partition Coefficient)
Butyl hydroxytoluene 128-37-0	5,1		OECD Guideline 107 (Partition Coefficient (n-octanol / water), Shake Flask Method)
Cumene hydroperoxide 80-15-9	2,16		not specified
Tetrahydrofurfuryl alcohol 97-99-4	-0,14	24,7 °C	OECD Guideline 107 (Partition Coefficient (n-octanol / water), Shake Flask Method)
1,1,2-Trichloroethane 79-00-5	> 2,05 - < 2,49	20 °C	QSAR (Quantitative Structure Activity Relationship)
Hydroquinone 123-31-9	0,59		EU Method A.8 (Partition Coefficient)

12.5. Results of PBT and vPvB assessment

Hazardous substances CAS-No.	PBT / vPvB
Tetrahydrofurfuryl methacrylate 2455-24-5	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
Methacrylic acid 79-41-4	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
2-Ethylhexyl methacrylate 688-84-6	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
1-Methyltrimethylene dimethacrylate 1189-08-8	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight≤700) 25068-38-6	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
Butyl hydroxytoluene 128-37-0	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
Cumene hydroperoxide 80-15-9	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
Hydroquinone 123-31-9	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.

12.6. Other adverse effects

No data available.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product disposal:
Dispose of in accordance with local and national regulations.
Collection and delivery to recycling enterprise or other registered elimination institution.

Disposal of uncleaned packages:
After use, tubes, cartons and bottles containing residual product should be disposed of as chemically contaminated waste in an authorised legal land fill site or incinerated.

Waste code

08 04 09 waste adhesives and sealants containing organic solvents and other dangerous substances
The valid EWC waste code numbers are source-related. The manufacturer is therefore unable to specify EWC waste codes for the articles or products used in the various sectors. The EWC codes listed are intended as a recommendation for users. We will be happy to advise you.

SECTION 14: Transport information

14.1. UN number

Not hazardous according to RID, ADR, ADN, IMDG, IATA-DGR.

14.2. UN proper shipping name

Not hazardous according to RID, ADR, ADN, IMDG, IATA-DGR.

14.3. Transport hazard class(es)

Not hazardous according to RID, ADR, ADN, IMDG, IATA-DGR.

14.4. Packing group

Not hazardous according to RID, ADR, ADN, IMDG, IATA-DGR.

14.5. Environmental hazards

Not hazardous according to RID, ADR, ADN, IMDG, IATA-DGR.

14.6. Special precautions for user

Not hazardous according to RID, ADR, ADN, IMDG, IATA-DGR.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

VOC content (2010/75/EC) < 3 %

15.2. Chemical safety assessment

A chemical safety assessment has not been carried out.

SECTION 16: Other information

The labelling of the product is indicated in Section 2. The full text of all abbreviations indicated by codes in this safety data sheet are as follows:

H242 Heating may cause a fire.
H302 Harmful if swallowed.
H311 Toxic in contact with skin.
H312 Harmful in contact with skin.
H314 Causes severe skin burns and eye damage.
H315 Causes skin irritation.
H317 May cause an allergic skin reaction.
H318 Causes serious eye damage.
H319 Causes serious eye irritation.
H331 Toxic if inhaled.
H332 Harmful if inhaled.
H335 May cause respiratory irritation.
H341 Suspected of causing genetic defects.
H351 Suspected of causing cancer.
H360 May damage fertility or the unborn child.
H360D May damage the unborn child.
H373 May cause damage to organs through prolonged or repeated exposure.
H400 Very toxic to aquatic life.
H410 Very toxic to aquatic life with long lasting effects.
H411 Toxic to aquatic life with long lasting effects.
H412 Harmful to aquatic life with long lasting effects.

Further information:

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This information is based on our current level of knowledge and relates to the product in the state in which it is delivered. It is intended to describe our products from the point of view of safety requirements and is not intended to guarantee any particular properties.

Relevant changes in this safety data sheet are indicated by vertical lines at the left margin in the body of this document. Corresponding text is displayed in a different color on shadowed fields.

Technical Data Sheet

LOCTITE® SF 7386

Known as LOCTITE® 7386
December 2014

PRODUCT DESCRIPTION

LOCTITE® SF 7386 provides the following product characteristics:

Technology	Activator for LOCTITE® toughened acrylic adhesives
Chemical Type	Substituted dihydropyridine
Solvent	n-Heptane and Isopropanol
Appearance	Transparent, yellow to light amber liquid[LMS]
Viscosity	Very low
Cure	Not applicable
Application	Cure promotion of toughened acrylic adhesives

LOCTITE® SF 7386 is designed to initiate the cure of Loctite toughened acrylic adhesives.

TYPICAL PROPERTIES

Specific Gravity @ 25 °C	0.8
Viscosity @ 25°C, mPa·s (cP)	1 to 2
Flash Point - See SDS	

TYPICAL PERFORMANCE

Fixture time and cure speed achieved as a result of using LOCTITE® SF 7386 depend on the adhesive used, the substrate bonded, surface cleanliness and whether one or two surface activation is used.

Fixture Time, ISO 4587, minutes:

Steel (degreased) using LOCTITE® 330™, , single side activation	≤4[LMS]

(Fixture time is defined as the time to develop a shear strength of 0.1 N/mm²)

Handling precautions

Activator must be handled in a manner applicable to highly flammable materials and in compliance with relevant local regulations.

The solvent can affect certain plastics or coatings. It is recommended to check all surfaces for compatibility before use.

GENERAL INFORMATION

This product is not recommended for use in pure oxygen and/or oxygen rich systems and should not be selected with a sealant for chlorine or other strong oxidizing materials.

For safe handling information on this product, consult the Safety Data Sheet (SDS).

Under no circumstances should activator and adhesive be mixed directly as liquids. Use only in a well ventilated area.

Where aqueous washing systems are used to clean the surfaces before bonding, it is important to check for compatibility of the washing solution with the adhesive. In some cases these aqueous washes can affect the cure and performance of the adhesive.

Directions for use:

1. Most surfaces may be bonded "as received" but contamination such as loose oxide layers or excessive oil may affect cure speed and bond strength. Cleaning is recommended if maximum strength is required.
2. Brush on the activator to one of the mating surfaces to be bonded. Apply adhesive to other surface.
3. For large gaps (>0.4 mm) or where maximum cure speed is required then treatment of both surfaces is recommended.
4. The activator will not dry and will remain active for up to 6 hours. Bond assembly should be completed within this time.
5. Where adhesive is applied onto an activated surface, assembly should be completed as quickly as possible (within 15 seconds).
6. Secure the assembly and await fixturing before any further handling..

Loctite Material Specification[LMS]

LMS dated July 08, 2004. Test reports for each batch are available for the indicated properties. LMS test reports include selected QC test parameters considered appropriate to specifications for customer use. Additionally, comprehensive controls are in place to assure product quality and consistency. Special customer specification requirements may be coordinated through Henkel Quality.

Storage

This activator is classified as **HIGHLY FLAMMABLE** and must be stored in an appropriate manner in compliance with relevant regulations. Do not store near oxidising agents or combustible materials. The product is light sensitve and accordingly, translucent containers should be kept in a dark place when not in use. Store product in the unopened container in a dry location. Storage information may also be indicated on the product container labelling.
Optimal Storage: 8 °C to 21 °C. Storage below 8 °C or greater than 28 °C can adversely affect product properties.
Material removed from containers may be contaminated during use. Do not return product to the original container. Henkel cannot assume responsibility for product which has been

contaminated or stored under conditions other than those previously indicated. If additional information is required, please contact your local Technical Service Center or Customer Service Representative.

Conversions
(°C x 1.8) + 32 = °F
kV/mm x 25.4 = V/mil
mm / 25.4 = inches
µm / 25.4 = mil
N x 0.225 = lb
N/mm x 5.71 = lb/in
N/mm² x 145 = psi
MPa x 145 = psi
N·m x 8.851 = lb·in
N·m x 0.738 = lb·ft
N·mm x 0.142 = oz·in
mPa·s = cP

Note:
The information provided in this Technical Data Sheet (TDS) including the recommendations for use and application of the product are based on our knowledge and experience of the product as at the date of this TDS. The product can have a variety of different applications as well as differing application and working conditions in your environment that are beyond our control. Henkel is, therefore, not liable for the suitability of our product for the production processes and conditions in respect of which you use them, as well as the intended applications and results. We strongly recommend that you carry out your own prior trials to confirm such suitability of our product.
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Reference 1.1

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Safety Data Sheet according to Regulation (EC) No 1907/2006

SDS No. : 173280
V006.0

7386 Activator

Revision: 28.02.2017
printing date: 15.01.2020
Replaces version from: 23.03.2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier
7386 Activator

Contains:
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics
Diethyl-phenyl-propyl-dihydropyridine

1.2. Relevant identified uses of the substance or mixture and uses advised against
Intended use:
Activator

1.3. Details of the supplier of the safety data sheet
Henkel Ltd
Wood Lane End
HP2 4RQ Hemel Hempstead

Great Britain

Phone: +44 1442 278000
Fax-no.: +44 1442 278071

ua-productsafety.uk@henkel.com

1.4. Emergency telephone number
24 Hours Emergency Tel: +44 (0)1442 278497

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (CLP):

Flammable liquids	Category 2
H225 Highly flammable liquid and vapor.	
Acute toxicity	Category 4
H302 Harmful if swallowed.	
Route of Exposure: Oral	
Skin irritation	Category 2
H315 Causes skin irritation.	
Serious eye irritation	Category 2
H319 Causes serious eye irritation.	
Specific target organ toxicity - single exposure	Category 3
H336 May cause drowsiness or dizziness.	
Target organ: Central Nervous System	
Aspiration hazard	Category 1
H304 May be fatal if swallowed and enters airways.	
Chronic hazards to the aquatic environment	Category 2
H411 Toxic to aquatic life with long lasting effects.	

2.2. Label elements

Label elements (CLP):

Hazard pictogram:	
Signal word:	Danger
Hazard statement:	H225 Highly flammable liquid and vapor. H302 Harmful if swallowed. H304 May be fatal if swallowed and enters airways. H319 Causes serious eye irritation. H315 Causes skin irritation. H336 May cause drowsiness or dizziness. H411 Toxic to aquatic life with long lasting effects.
Precautionary statement:	***For consumer use only: P101 If medical advice is needed, have product container or label at hand. P102 Keep out of reach of children. P501 Dispose of waste and residues in accordance with local authority requirements***
Precautionary statement: Prevention	P210 Keep away from heat/open flames/hot surfaces. - No smoking. P261 Avoid breathing vapours. P273 Avoid release to the environment.
Precautionary statement: Response	P301+P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor. P302+P352 IF ON SKIN: Wash with plenty of soap and water. P331 Do NOT induce vomiting. P337+P313 If eye irritation persists: Get medical advice/attention.

2.3. Other hazards
None if used properly.
Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

General chemical description:
Solvent based activator.

Declaration of the ingredients according to CLP (EC) No 1272/2008:

Hazardous components CAS-No.	EC Number REACH-Reg No.	content	Classification
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	300-230-4 01-2119475515-33	50- < 75 %	Asp. Tox. 1 H304 Skin Irrit. 2 H315 Flam. Liq. 2 H225 STOT SE 3; Inhalation H336 Aquatic Chronic 2 H411
Diethyl-phenyl-propyl-dihydropyridine 34562-31-7	252-091-3	25- < 50 %	Acute Tox. 4; Oral H302 Acute Tox. 4; Dermal H312 Skin Irrit. 2; Dermal H315 Eye Irrit. 2 H319 Aquatic Chronic 4 H413
Propan-2-ol 67-63-0	200-661-7 01-2119457558-25	10- < 25 %	Flam. Liq. 2 H225 Eye Irrit. 2 H319 STOT SE 3 H336

For full text of the H - statements and other abbreviations see section 16 "Other information".
Substances without classification may have community workplace exposure limits available.

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation:
Move to fresh air.
Seek medical advice.

Skin contact:
Rinse with running water and soap.
Obtain medical attention if irritation persists.

Eye contact:
Rinse immediately with plenty of running water (for 10 minutes). Seek medical attention if necessary.

Ingestion:
Rinse mouth, drink 1-2 glasses of water, do not induce vomiting, consult a doctor.

4.2. Most important symptoms and effects, both acute and delayed
EYE: Irritation, conjunctivitis.

SKIN: Redness, inflammation.

INGESTION: Nausea, vomiting, diarrhea, abdominal pain.

ASPIRATION: Coughing, shortness of breath, nausea. Delayed effect: bronchopneumonia or pulmonary oedema

Vapors may cause drowsiness and dizziness.

4.3. Indication of any immediate medical attention and special treatment needed
Swallowing may cause irritation of mouth, throat and digestive tract, diarrhea and vomiting

Do not induce vomiting.
Seek medical attention from a specialist.
See section: Description of first aid measures

SECTION 5: Firefighting measures

5.1. Extinguishing media
Suitable extinguishing media:
Foam, extinguishing powder, carbon dioxide.

Extinguishing media which must not be used for safety reasons:
High pressure waterjet

5.2. Special hazards arising from the substance or mixture
In the event of a fire, carbon monoxide (CO), carbon dioxide (CO2) and nitrogen oxides (NOx) can be released.
Vapours may accumulate in low or confined areas, travel considerable distance to source of ignition, and flash back.

5.3. Advice for firefighters
Wear self-contained breathing apparatus and full protective clothing, such as turn-out gear.

Additional information:
In case of fire, keep containers cool with water spray.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Avoid contact with skin and eyes.
Ensure adequate ventilation.
Wear protective equipment.

6.2. Environmental precautions
Do not empty into drains / surface water / ground water.

6.3. Methods and material for containment and cleaning up
For small spills wipe up with paper towel and place in container for disposal.
For large spills absorb onto inert absorbent material and place in sealed container for disposal.

6.4. Reference to other sections
See advice in section 8

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Keep away from sources of ignition - no smoking.
Vapours should be extracted to avoid inhalation.
Use only in well-ventilated areas.
Avoid skin and eye contact.
See advice in section 8

Hygiene measures:
Wash hands before work breaks and after finishing work.
Do not eat, drink or smoke while working.
Good industrial hygiene practices should be observed.

7.2. Conditions for safe storage, including any incompatibilities
Store in a cool, dry place.
Do not store near sources of heat or ignition, or reactive materials.
Refer to Technical Data Sheet

7.3. Specific end use(s)
Activator

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational Exposure Limits

Valid for
Great Britain

Ingredient [Regulated substance]	ppm	mg/m³	Value type	Short term exposure limit category / Remarks	Regulatory list
Propan-2-ol 67-63-0 [PROPAN-2-OL]	500	1.250	Short Term Exposure Limit (STEL):		EH40 WEL
Propan-2-ol 67-63-0 [PROPAN-2-OL]	400	999	Time Weighted Average (TWA):		EH40 WEL

Occupational Exposure Limits

Valid for
Ireland

Ingredient [Regulated substance]	ppm	mg/m³	Value type	Short term exposure limit category / Remarks	Regulatory list
Propan-2-ol 67-63-0 [ISOPROPYL ALCOHOL]	400		Short Term Exposure Limit (STEL):		IR_OEL
Propan-2-ol 67-63-0 [ISOPROPYL ALCOHOL]	200		Time Weighted Average (TWA):		IR_OEL
Propan-2-ol 67-63-0 [ISOPROPYL ALCOHOL]			Skin designation:	Can be absorbed through the skin.	IR_OEL

Predicted No-Effect Concentration (PNEC):

Name on list	Environmental Compartment	Exposure period	Value				Remarks
			mg/l	ppm	mg/kg	others	
Propan-2-ol 67-63-0	aqua (freshwater)		140,9 mg/l				
Propan-2-ol 67-63-0	aqua (marine water)		140,9 mg/l				
Propan-2-ol 67-63-0	sediment (freshwater)				552 mg/kg		
Propan-2-ol 67-63-0	sediment (marine water)				552 mg/kg		
Propan-2-ol 67-63-0	soil				28 mg/kg		
Propan-2-ol 67-63-0	aqua (intermittent releases)		140,9 mg/l				
Propan-2-ol 67-63-0	sewage treatment plant (STP)		2251 mg/l				
Propan-2-ol 67-63-0	oral				160 mg/kg		

Derived No-Effect Level (DNEL):

Name on list	Application Area	Route of Exposure	Health Effect	Exposure Time	Value	Remarks
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	Workers	dermal	Long term exposure - systemic effects		300 mg/kg bw/day	
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	Workers	Inhalation	Long term exposure - systemic effects		2085 mg/m3	
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	General population	dermal	Long term exposure - systemic effects		149 mg/kg bw/day	
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	General population	oral	Long term exposure - systemic effects		149 mg/kg bw/day	
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	General population	Inhalation	Long term exposure - systemic effects		447 mg/m3	
Propan-2-ol 67-63-0	Workers	dermal	Long term exposure - systemic effects		888 mg/kg	
Propan-2-ol 67-63-0	Workers	inhalation	Long term exposure - systemic effects		500 mg/m3	
Propan-2-ol 67-63-0	General population	dermal	Long term exposure - systemic effects		319 mg/kg	
Propan-2-ol 67-63-0	General population	inhalation	Long term exposure - systemic effects		89 mg/m3	
Propan-2-ol 67-63-0	General population	oral	Long term exposure - systemic effects		26 mg/kg	

Biological Exposure Indices:
None

8.2. Exposure controls:

Engineering controls:
Ensure good ventilation/extraction.

Respiratory protection:
Ensure adequate ventilation.
An approved mask or respirator fitted with an organic vapour cartridge should be worn if the product is used in a poorly ventilated area
Filter type: A (EN 14387)

Hand protection:
Chemical-resistant protective gloves (EN 374).
Suitable materials for short-term contact or splashes (recommended: at least protection index 2, corresponding to > 30 minutes permeation time as per EN 374):
nitrile rubber (NBR; >= 0.4 mm thickness)
Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374):
nitrile rubber (NBR; >= 0.4 mm thickness)
This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced.

Eye protection:
Safety glasses with sideshields or chemical safety goggles should be worn if there is a risk of splashing.
Protective eye equipment should conform to EN166.

Skin protection:
Wear suitable protective clothing.
Protective clothing should conform to EN 14605 for liquid splashes or to EN 13982 for dusts.

Advices to personal protection equipment:

The information provided on personal protective equipment is for guidance purposes only. A full risk assessment should be conducted prior to using this product to determine the appropriate personal protective equipment to suit local conditions. Personal protective equipment should conform to the relevant EN standard.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	liquid clear yellow, Amber, greenish
Odor	Aliphatic
Odour threshold	No data available / Not applicable
pH	Not applicable
Initial boiling point	82 °C (179.6 °F)
Flash point	-5 °C (23 °F)
Decomposition temperature	No data available / Not applicable
Vapour pressure (20 °C (68 °F))	35 mm hg
Density ()	0,8 g/cm3
Bulk density	No data available / Not applicable
Viscosity	No data available / Not applicable
Viscosity (kinematic)	No data available / Not applicable
Explosive properties	No data available / Not applicable
Solubility (qualitative)	Insoluble
Solidification temperature	No data available / Not applicable
Melting point	No data available / Not applicable
Flammability	No data available / Not applicable
Auto-ignition temperature	No data available / Not applicable
Explosive limits	No data available / Not applicable
Partition coefficient: n-octanol/water	No data available / Not applicable
Evaporation rate	No data available / Not applicable
Vapor density	Heavier than air
Oxidising properties	No data available / Not applicable

9.2. Other information

No data available / Not applicable

SECTION 10: Stability and reactivity

10.1. Reactivity
Strong oxidizing agents.

10.2. Chemical stability
Stable under recommended storage conditions.

10.3. Possibility of hazardous reactions
See section reactivity

10.4. Conditions to avoid
Stable under normal conditions of storage and use.
Heat, flames, sparks and other sources of ignition.

10.5. Incompatible materials
See section reactivity.

10.6. Hazardous decomposition products
None if used for intended purpose.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

General toxicological information:
The mixture is classified based on the available hazard information for the ingredients as defined in the classification criteria for mixtures for each hazard class or differentiation in Annex I to Regulation (EC) No 1272/2008. Relevant available health/ecological information for the substances listed under Section 3 is provided in the following.

STOT-single exposure:
May cause drowsiness or dizziness.

Aspiration hazard:
May be fatal if swallowed and enters airways.

Oral toxicity:
Harmful if swallowed.

Inhalative toxicity:
May cause irritation to respiratory system.

Skin irritation:
Causes skin irritation.

Eye irritation:
Causes serious eye irritation.

Acute oral toxicity:

Hazardous components CAS-No.	Value type	Value	Route of application	Exposure time	Species	Method
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	LD50	> 5.840 mg/kg	oral		rat	OECD Guideline 401 (Acute Oral Toxicity)
Propan-2-ol 67-63-0	LD50	5.840 mg/kg	oral		rat	OECD Guideline 401 (Acute Oral Toxicity)

Acute inhalative toxicity:

Hazardous components CAS-No.	Value type	Value	Route of application	Exposure time	Species	Method
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	LC50	> 23,3 mg/l	vapour	4 h	rat	OECD Guideline 403 (Acute Inhalation Toxicity)
Propan-2-ol 67-63-0	LC50	72,6 mg/l		4 h	rat	not specified

Acute dermal toxicity:

Hazardous components CAS-No.	Value type	Value	Route of application	Exposure time	Species	Method
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	LD50	> 2.920 mg/kg	dermal		rat	OECD Guideline 402 (Acute Dermal Toxicity)
Propan-2-ol 67-63-0	LD50	12.870 mg/kg	dermal		rabbit	not specified

Skin corrosion/irritation:

Hazardous components CAS-No.	Result	Exposure time	Species	Method
Diethyl-phenyl-propyl-dihydropyridine 34562-31-7	irritating			Expert judgement
Propan-2-ol 67-63-0	slightly irritating	4 h	rabbit	OECD Guideline 404 (Acute Dermal Irritation / Corrosion)

Serious eye damage/irritation:

Hazardous components CAS-No.	Result	Exposure time	Species	Method
Diethyl-phenyl-propyl-dihydropyridine 34562-31-7	irritating			Expert judgement
Propan-2-ol 67-63-0	moderately irritating		rabbit	OECD Guideline 405 (Acute Eye Irritation / Corrosion)

Respiratory or skin sensitization:

Hazardous components CAS-No.	Result	Test type	Species	Method
Propan-2-ol 67-63-0	not sensitising	Buehler test	guinea pig	OECD Guideline 406 (Skin Sensitisation)

Germ cell mutagenicity:

Hazardous components CAS-No.	Result	Type of study / Route of administration	Metabolic activation / Exposure time	Species	Method
Propan-2-ol 67-63-0	negative with metabolic activation	mammalian cell gene mutation assay	with and without		OECD Guideline 476 (In vitro Mammalian Cell Gene Mutation Test)
Propan-2-ol 67-63-0	negative	intraperitoneal		mouse	OECD Guideline 474 (Mammalian Erythrocyte Micronucleus Test)

Carcinogenicity:

Hazardous components CAS-No.	Result	Species	Sex	Exposure timeFrequency of treatment	Route of application	Method
Propan-2-ol 67-63-0		rat	male/female	104 w 6 h/d, 5 d/w	inhalation: vapour	OECD Guideline 451 (Carcinogenicity Studies)

Reproductive toxicity:

Hazardous substances CAS-No.	Result / Classification	Species	Exposure time	Species	Method
Propan-2-ol 67-63-0	NOAEL P = 853 mg/kg	One generation study oral: drinking water		rat	OECD Guideline 415 (One-Generation Reproduction Toxicity Study)
	NOAEL P = 500 mg/kg NOAEL F1 = 1.000 mg/kg	Two generation study oral: gavage		rat	OECD Guideline 416 (Two-Generation Reproduction Toxicity Study)

Repeated dose toxicity

Hazardous components CAS-No.	Result	Route of application	Exposure time / Frequency of treatment	Species	Method
Propan-2-ol 67-63-0		inhalation: vapour	at least 104 w6 h/d, 5 d/w	rat	not specified

SECTION 12: Ecological information

General ecological information:
The mixture is classified based on the available hazard information for the ingredients as defined in the classification criteria for mixtures for each hazard class or differentiation in Annex I to Regulation (EC) No 1272/2008. Relevant available health/ecological information for the substances listed under Section 3 is provided in the following.

12.1. Toxicity

Ecotoxicity:
Toxic to aquatic life with long lasting effects.
Do not empty into drains / surface water / ground water.

Hazardous components CAS-No.	Value type	Value	Acute Toxicity Study	Exposure time	Species	Method
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	EC50	3 mg/l	Daphnia	48 h	Daphnia magna	OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	NOEC	0,17 mg/l	chronic Daphnia	21 d	Daphnia magna	OECD 211 (Daphnia magna, Reproduction Test)
Propan-2-ol 67-63-0	LC50	> 9.640 - 10.000 mg/l	Fish	96 h	Pimephales promelas	OECD Guideline 203 (Fish, Acute Toxicity Test)
Propan-2-ol 67-63-0	EC50	> 1.000 mg/l	Algae	96 h	Scenedesmus subspicatus (new name: Desmodesmus subspicatus)	OECD Guideline 201 (Alga, Growth Inhibition Test)
	NOEC	1.000 mg/l	Algae	96 h	Scenedesmus subspicatus (new name: Desmodesmus subspicatus)	OECD Guideline 201 (Alga, Growth Inhibition Test)
Propan-2-ol 67-63-0	EC 50	> 1.000 mg/l	Bacteria	3 h		OECD Guideline 209 (Activated Sludge, Respiration Inhibition Test)
Propan-2-ol 67-63-0	NOEC	30 mg/l	chronic Daphnia	21 d	Daphnia magna	OECD 211 (Daphnia magna, Reproduction Test)

12.2. Persistence and degradability

Persistence and Biodegradability:
No data available.

Hazardous components CAS-No.	Result	Route of application	Degradability	Method
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	readily biodegradable	aerobic	98 %	OECD Guideline 301 F (Ready Biodegradability: Manometric Respirometry Test)
Propan-2-ol 67-63-0	readily biodegradable	aerobic	70 - 84 %	EU Method C.4-E (Determination of the "Ready" BiodegradabilityClosed Bottle Test)

12.3. Bioaccumulative potential / 12.4. Mobility in soil

Mobility:
The product evaporates readily.

Bioaccumulative potential:
No data available.

Hazardous components CAS-No.	LogPow	Bioconcentration factor (BCF)	Exposure time	Species	Temperature	Method
Propan-2-ol 67-63-0	0,05					OECD Guideline 107 (Partition Coefficient (n-octanol / water), Shake Flask Method)

12.5. Results of PBT and vPvB assessment

Hazardous components CAS-No.	PBT/vPvB
Hydrocarbons, C7, n-alkanes, isoalkanes, cyclics 93924-37-9	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.
Propan-2-ol 67-63-0	Not fulfilling Persistent, Bioaccumulative and Toxic (PBT), very Persistent and very Bioaccumulative (vPvB) criteria.

12.6. Other adverse effects

No data available.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product disposal:
Collection and delivery to recycling enterprise or other registered elimination institution.
Dispose of in accordance with local and national regulations.

Disposal of uncleaned packages:
After use, tubes, cartons and bottles containing residual product should be disposed of as chemically contaminated waste in an authorised legal land fill site or incinerated.
Disposal must be made according to official regulations.

Waste code

14 06 03 - other solvents and solvent mixtures

The valid EWC waste code numbers are source-related. The manufacturer is therefore unable to specify EWC waste codes for the articles or products used in the various sectors. The EWC codes listed are intended as a recommendation for users. We will be happy to advise you.

SECTION 14: Transport information

14.1. UN number

ADR	1993
RID	1993
ADN	1993
IMDG	1993
IATA	1993

14.2. UN proper shipping name

ADR	FLAMMABLE LIQUID, N.O.S. (Heptanes,Isopropanol)
RID	FLAMMABLE LIQUID, N.O.S. (Heptanes,Isopropanol)
ADN	FLAMMABLE LIQUID, N.O.S. (Heptanes,Isopropanol)
IMDG	FLAMMABLE LIQUID, N.O.S. (Heptanes,Isopropanol)
IATA	Flammable liquid, n.o.s. (Heptanes,Isopropanol)

14.3. Transport hazard class(es)

ADR	3
RID	3
ADN	3
IMDG	3
IATA	3

14.4. Packing group

ADR	II
RID	II
ADN	II
IMDG	II
IATA	II

14.5. Environmental hazards

ADR	Environmentally Hazardous
RID	Environmentally Hazardous
ADN	Environmentally Hazardous
IMDG	Marine pollutant
IATA	not applicable

14.6. Special precautions for user

ADR	Special provision 640D Tunnelcode: (D/E)
RID	Special provision 640D
ADN	Special provision 640D
IMDG	not applicable
IATA	not applicable

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

VOC content (2010/75/EC) 100 %

15.2. Chemical safety assessment

A chemical safety assessment has not been carried out.

SECTION 16: Other information

The labelling of the product is indicated in Section 2. The full text
of all abbreviations indicated by codes in this safety data sheet are as follows:

H225 Highly flammable liquid and vapor.
H302 Harmful if swallowed.
H304 May be fatal if swallowed and enters airways.
H312 Harmful in contact with skin.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H336 May cause drowsiness or dizziness.
H411 Toxic to aquatic life with long lasting effects.
H413 May cause long lasting harmful effects to aquatic life.

Further information:
This information is based on our current level of knowledge and relates to the product in the state in which it is delivered. It is intended to describe our products from the point of view of safety requirements and is not intended to guarantee any particular properties.

Relevant changes in this safety data sheet are indicated by vertical lines at the left margin in the body of this document. Corresponding text is displayed in a different color on shadowed fields.