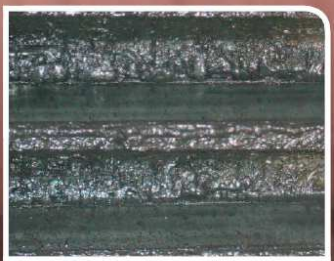
RAW MATERIALS PROCESS INDUSTRIES

OPEN GEAR DRIVES

LUBRICLEAN EP : WHILE OPERATING CLEANING



BEFORE

AFTER 1 HOUR
OF USING LUBRICLEAN EP

LUBRILOG

LUBRICATION ENGINEERING

WWW.LUBRILOG.FR

LUBRICLEAN EP : while operating cleaning

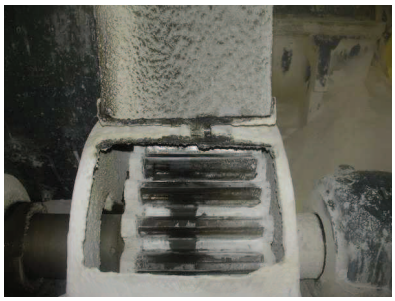
Large open gear drives operate in difficult environments and are subject to pollution by abrasive dusts such as clinker, coal, sand, abrasives, metallic powders, etc...

For this reason, traditional operations designed to limit the effects of pollution must be strictly implemented, these include:

- Installation of housing protections around the open gears and control of the sealing
- Lubricant replacement and analysis (splash or circulation lubrication)
- Filter maintenance and cleaning (circulation lubrication)
- No lubricant contamination at installation
- Inspection of the condition and lubrication of the working flanks

However, these are not always sufficient in case of serious abrasive pollution.

LUBRILOG technical department have therefore developed a specific « green » solvent, the **LUBRICLEAN EP**, designed to scour and clean very dirty open gear drives while operating, even under heavy loads.



The lubricant and its application system must be protected.

Cleaning operations must be executed by plant technicians or by specialized companies. A **LUBRILOG** technician may be available to perform primary cleaning and demonstrate the while operating cleaning method's efficiency. He can also train plant technicians for this operation.

While operating cleaning objectives

The two major situations in which while operating cleaning with **LUBRICLEAN EP** is recommended are:

- **Preparation of an action on the gear set to clean the old lubricant**
- **Acting, preventively or not, on the abrasive wear caused by polluting material**

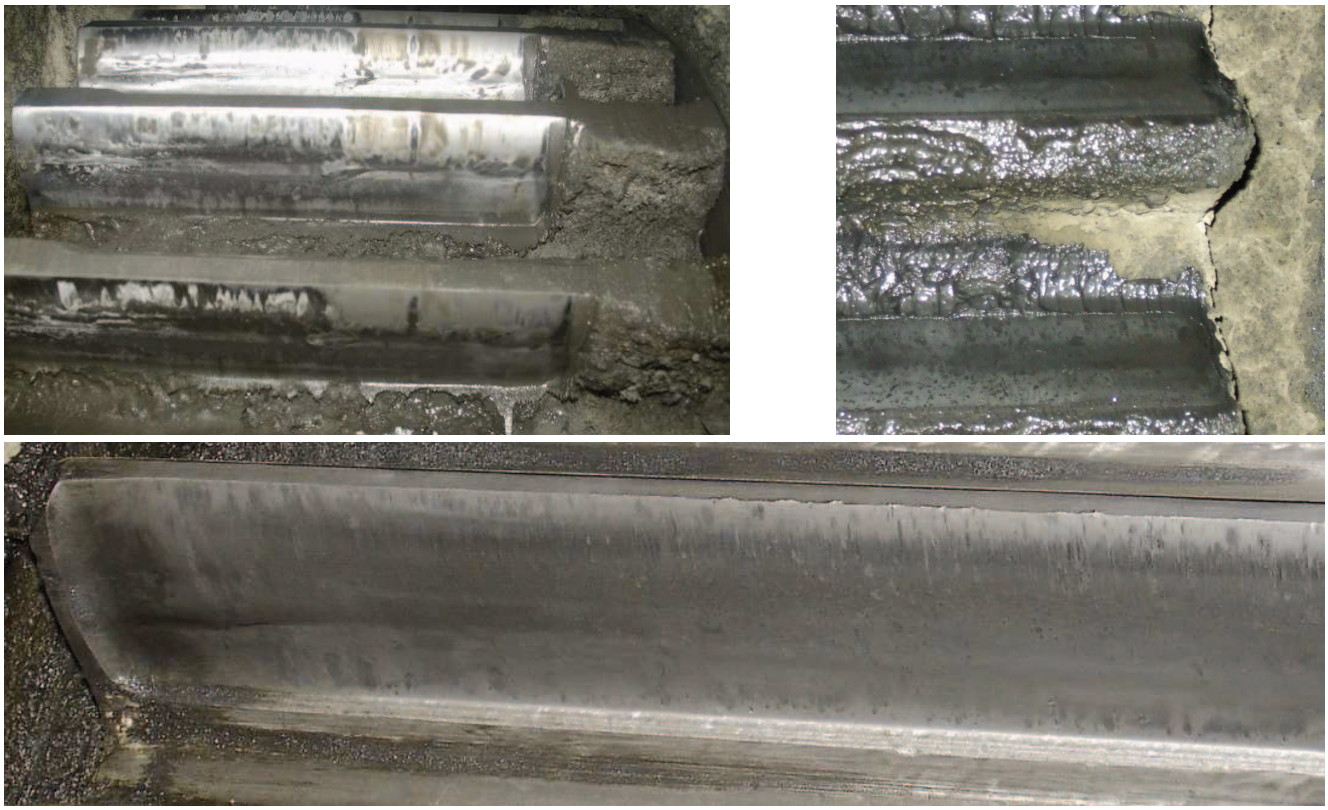
Preparation of an intervention:

Prior to any intervention on an open gear drive, whether for gear set inspections or for any other mechanical operation (alignment, repair, reverse, replacement), **LUBRICLEAN EP** can be used to prepare it. This cleaning agent provides a quick and affordable cleaning solution for the lubricant present on the teeth and inside the housing.

Protection against abrasive wear:

« Abrasive wear » (ISO standard 10825) can cause serious deterioration to fast gear set working flanks.
The damages caused by this type of wear are not hazardous if stopped promptly.

For this reason, it is crucial to protect the working flanks and, in the most severe cases, preventive cleaning with **LUBRICLEAN EP** can provide this protection at an affordable cost a common situation in the mining industry.



Examples of teeth needing to be cleaned (images above) and of the effects of abrasion on working flanks (lower image).

While operating cleaning advantages

The main advantages of while operating cleaning for large open gear drives are:

- **Effective cleaning and associated lubrication (while operating operation)**
- **Reduced production interruptions**
- **Simple, secure and quick setup (1 hour cleaning operation)**
- **Non-toxic for the environment and the operators (« green » solvent)**

These aspects make **LUBRICLEAN EP** an affordable and efficient cleaning method.

While operating cleaning methodology

While operating cleaning can be performed on any type of lubrication system permanent or intermittent lubrication. We will describe the cleaning method applied on a spray lubrication gear set. **LUBRILOG** will provide its customers with the appropriate procedure for the methods to use on splash and circulation lubrication gear drives.

Gear drives that are spray-lubricated with grease are most subject to abrasive wear pollution, called « wear with three bodies ». The low circulation of lubricant on the active flanks allows abrasive particles to agglomerate with the lubricant at the bottom of the teeth and to frequently pollute the working flanks.

Cleaning preparation:

- **Installation of a recuperation tank for the used solvent under the housing**
- **Preparation of the high-pressure pump and prior operating tests**
- **Installation of the LUBRICLEAN EP drums**

Note:
The processed load, in the case of a mill, will be reduced for the duration of the cleaning intervention.

The cleaning operation will be completed through the inspection door of the inward pinion (IN pinion) for double drive gear sets and through the inspection door of the outward pinion (OUT pinion) for single drive gear sets.

Example of a used solvent evacuation tank.

Cleaning pump (example)

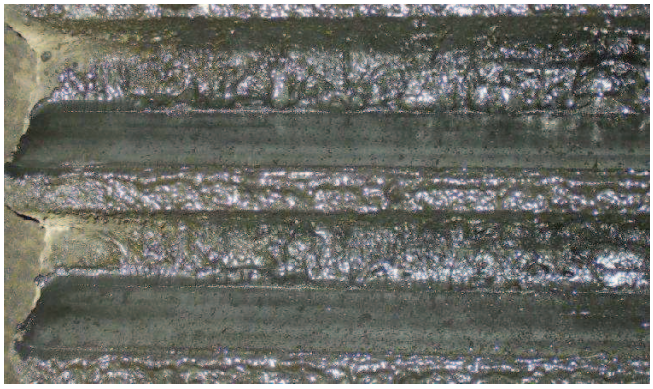
Spray lubrication: steps of while operating cleaning:

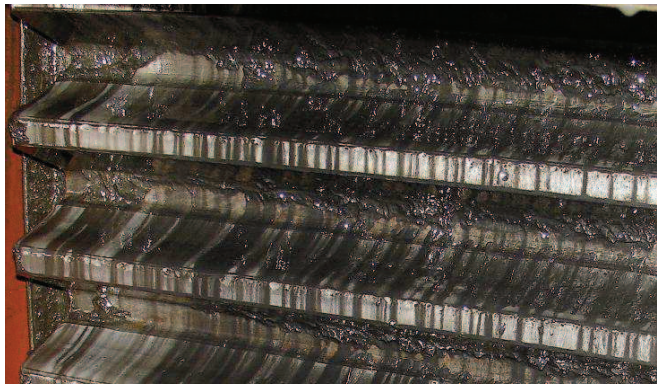
- **Open the inspection door**
- **Stop the lubrication system**
- **Spray LUBRICLEAN EP for 8 minutes at high pressure (200 bars or 2900 psi, at 12 to 16 liters per minute)**
- **Stop spraying LUBRICLEAN EP for 10 minutes to let it soak in**
- **Spray LUBRICLEAN EP again at high pressure (200 bars or 2900 psi, at 12 to 16 liters per minute)**

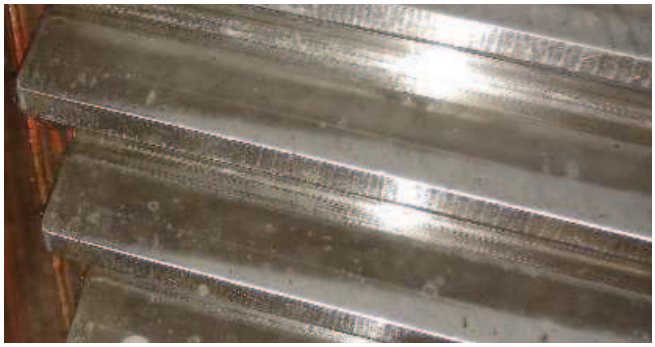
A very short interruption is necessary to verify the cleanliness. Depending on the level of cleanliness observed and the operational lubricant to be cleaned, slow finishing with an auxiliary drive may be useful to clean the bottom of the teeth (slow cleaning for about 5 minutes).

The cleaning operation will last about one hour. The teeth will then be covered with an extreme pressure protection film.

Warning:
Before restarting the gear drive, it is necessary to complete the lubrication of the teeth with the priming grease **GRAFOLOG H 1** or with the operational lubricant. The gear drive will be sprayed continuously for at least 4 hours.







Different phases of a mill's open gear drive while operating cleaning.

While operating cleaning: high pressure pump advised

For cleaning with the **LUBRICLEAN EP** we advise the high pressure pump **NOVOJET 15/200**, a spray nozzle with a spray angle of 15 ° and a manual priming pump with cane diver.
Another pump selection can be done, but we recommend the following values to make a perfect cleaning: pressure of 200 bar and a minimum rate of 10 to 15 liters per minute.
The priming pump is necessary for permanent operation of the high pressure pump and the spray angle of the nozzle of 15 ° allows a perfect concentration of the jet of **LUBRICLEAN EP** on the working flanks to be cleaned.

NOVOJET technical features:

Model	Max. pressure (bar / psi)	Capacity (lt/mn)	Motor power (kW)	Voltage (V - Hz)	Dimensions LxPxH (cm)	Net weigth (kg)
15 / 200	200 / 2900	15	5,5	380 - 50	55 x 55 x 70	60

Equipements standards : High pressure hose R2, 10 mt. and washing lance cm. 120 with automatic gun.

High pressure pump NOVOJET 15/200

Before using the high pressure pump, it is imperative to consult the instructions for use and maintenance available from our Technical Department.
The detailed procedure of cleaning with **LUBRICLEAN EP** is at the end of this document.

Hand pump on drum for the high pressure pump priming

High pressure lance with automatic gun and adjustable nozzle (jet opening of a minimum 15° angle)

While operating cleaning: implementation description

The operation is performed by a plant technician or a cleaning company and involves several steps that must be respected.
The intervention takes place while the machine is running at reduced load (but during production) to reduce the forces applied on the working flanks of the open gear set (girth gear-pinion).
LUBRICLEAN EP spraying is performed for one hour on an open gear drive lubricated by spraying, dip or circulation.

The procedure described below is based on the experience of the **LUBRILOG** Company and requires:

- Two operators (one for spraying the **LUBRICLEAN EP** and one for its continuous supply)
- A complete personal protective waterproof equipment for spray operator,
- A tether to secure the spray lance (prohibiting any contact between the lance and the gear set)
- A high pressure pump **NOVOJET 200/15** (see the description of the pump)
- A manual priming pump was on a cane diver to reach the bottom of the 200 liters drum
- Two, three or four 200 liter drums of **LUBRICLEAN EP**
- Recycling tanks for the mixing "used lubricant & **LUBRICLEAN EP**"
- Electricity
- About one hour

The success of the **LUBRICLEAN EP** method is due to this easy implementation.

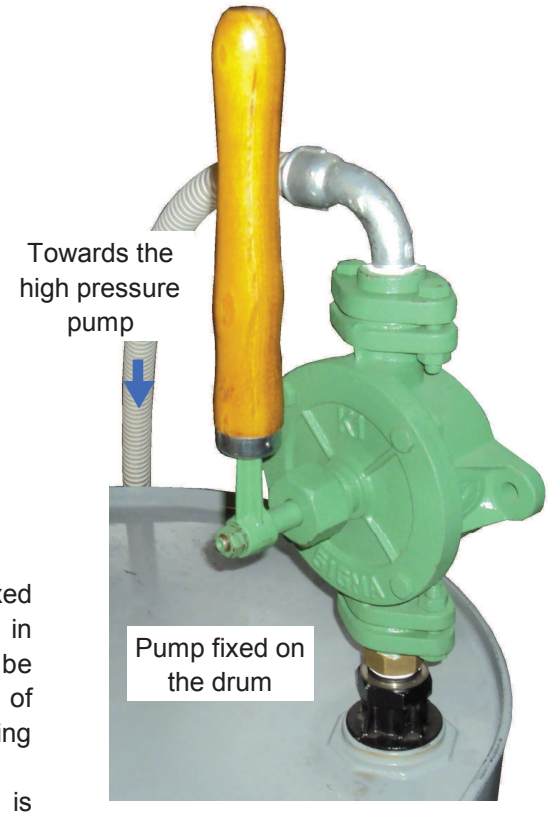
In the case of a mechanical intervention preparation requires cleanup "at white" surfaces, a manual finishing is expected but will be greatly facilitated by impregnating the residual contamined lubricant with the **LUBRICLEAN EP** (in this case asking the mechanical Company on their requirements of cleanliness is necessary).

Warning:
Other high-pressure pumps can be used with or without priming pump, but we recommend to meet the same technical characteristics to obtain a quality cleaning without risk to open gear drive. Otherwise, we do not guarantee the smooth running of the operation and its results.

While operating cleaning: implementation and connection of the high pressure pump, the priming pump and the spray lance

Setting up of the manual priming pump with cane diver:

The priming pump is designed to supply the high pressure pump in **LUBRICLEAN EP** to prevent dry running.

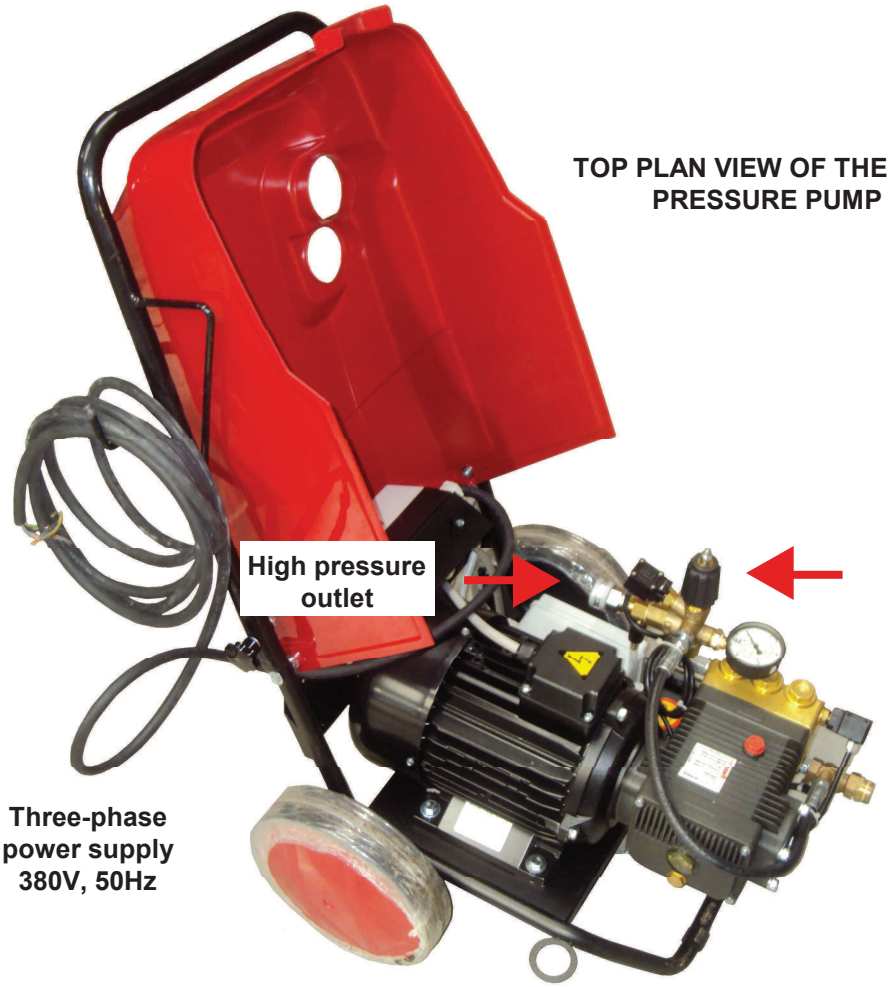


The priming pump must remain in place during cleaning and be fixed to the drum to improve rigidity of the assembly (to ease handling in the pump handle). However, when the drum is empty and need to be change, the pump must be removed quickly to ensure continuity of supply **LUBRICLEAN EP** (attention to pollution when changing drum).
We recommend disconnecting the pump when priming operation is over and just before cleaning but leaving it in place on the drum.

Setting up of the high pressure pump:

NOVOJET 200/15 high pressure pump general view.

TOP PLAN VIEW OF THE HIGH PRESSURE PUMP



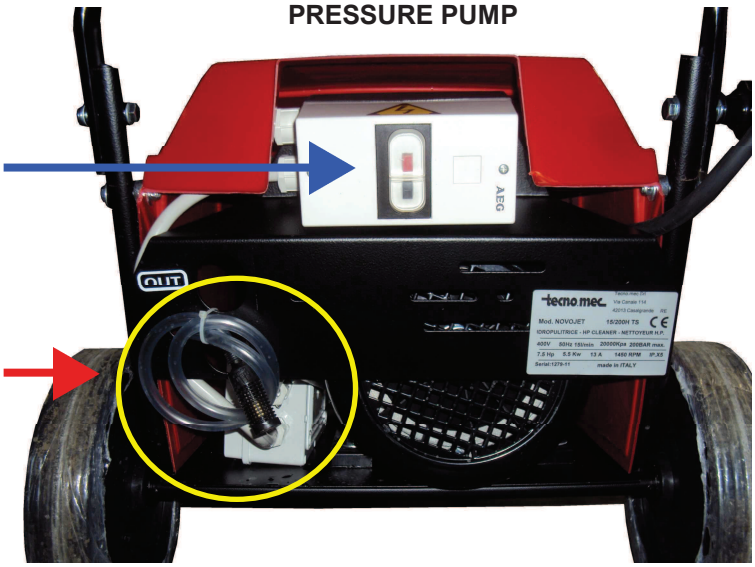
High pressure outlet

Pressure setting knob : not change the initial setting

Low pressure inlet (1/2 ") with metal filter

Three-phase power supply 380V, 50Hz

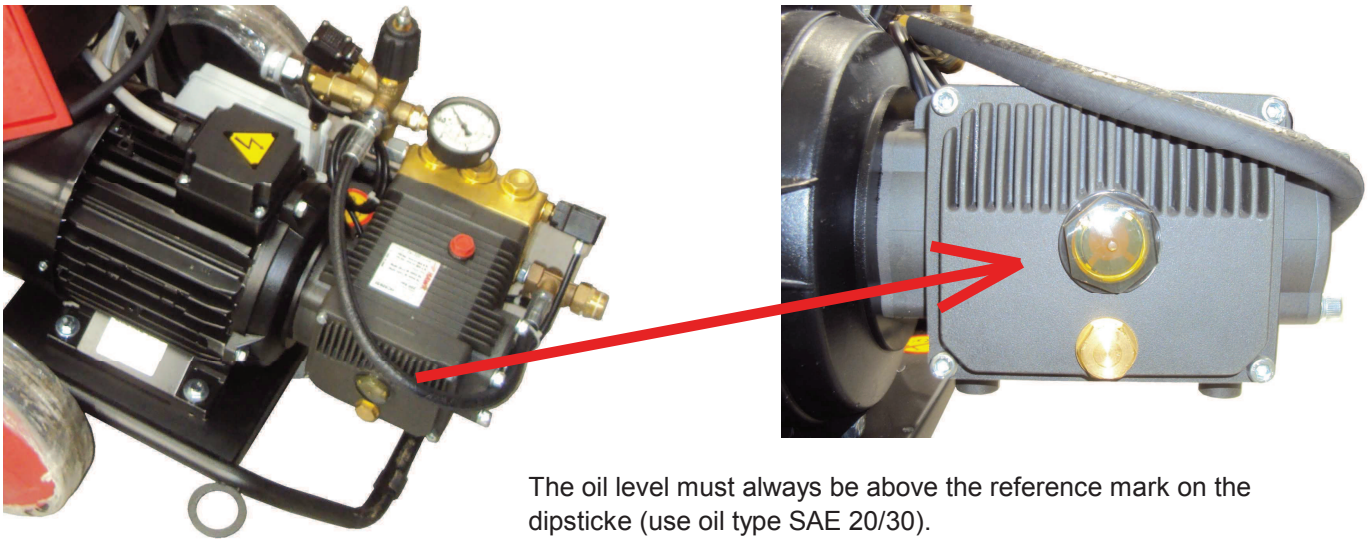
REAR OF THE HIGH PRESSURE PUMP



Switch ON (green) and switch OFF (red)

Detergent circuit not to use (adapted for cleaning with water)

Lubrication of the pump must be checked before the intervention: control of oil level.

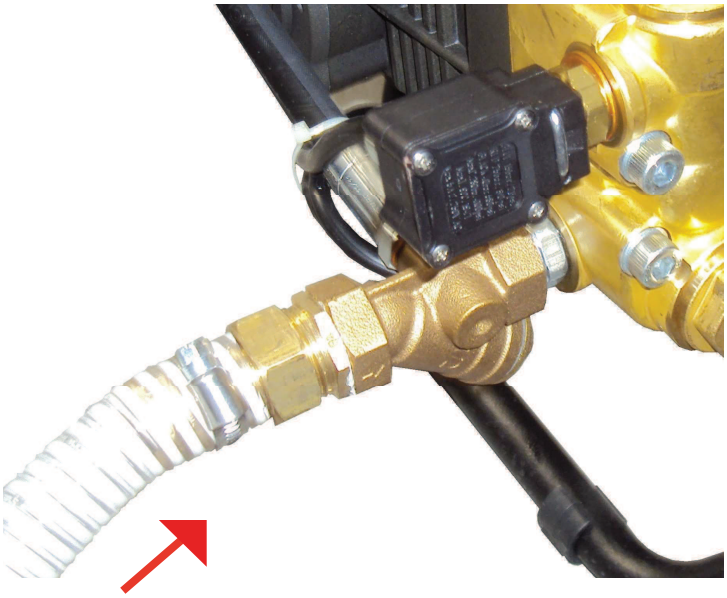


The oil level must always be above the reference mark on the dipsticke (use oil type SAE 20/30).
Follow the instructions in the manufacturer's manual.

The high pressure pump is connected to the priming pump (input **LUBRICLEAN EP**).
The photographs below show the connections to make.

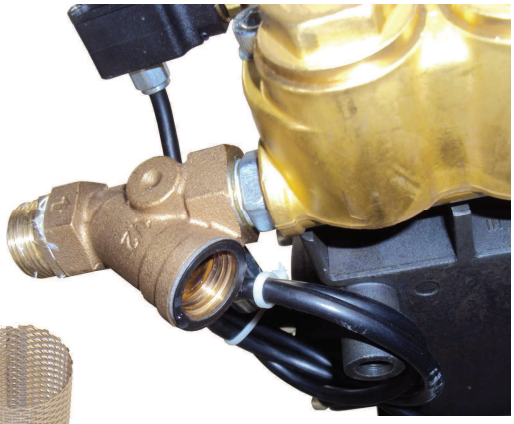
It is advisable to test the spray before the cleaning, for example with water.

The length of hose should be checked before the operation (particularly the length between the pump and spray lance).



Low pressure inlet (connection 1/2 ") to connect with **LUBRICLEAN EP** drum

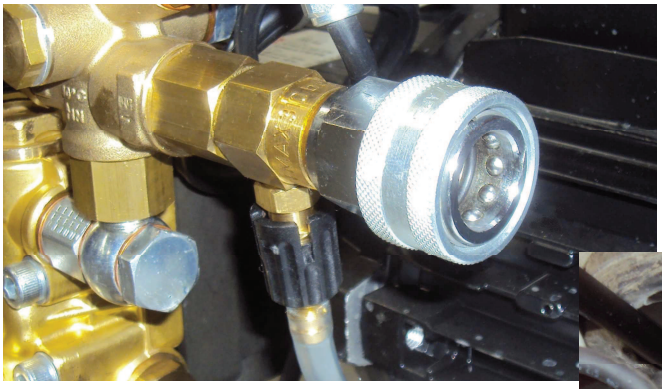
LUBRICLEAN EP low pressure inlet (connection 1/2 ") with metal filter



Metalic filter
Ø16,5 mm x 25 mm

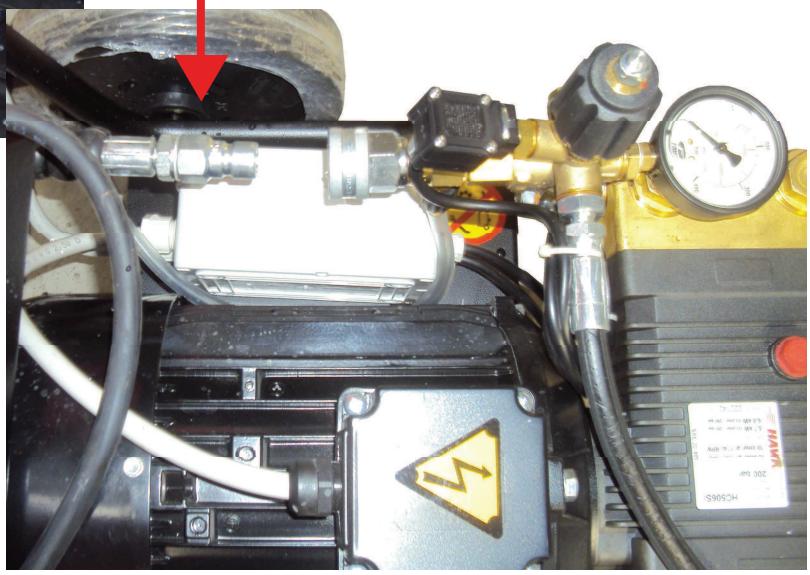
The metal filter must be cleaned regularly

The high pressure pump is connected to the spray lance:

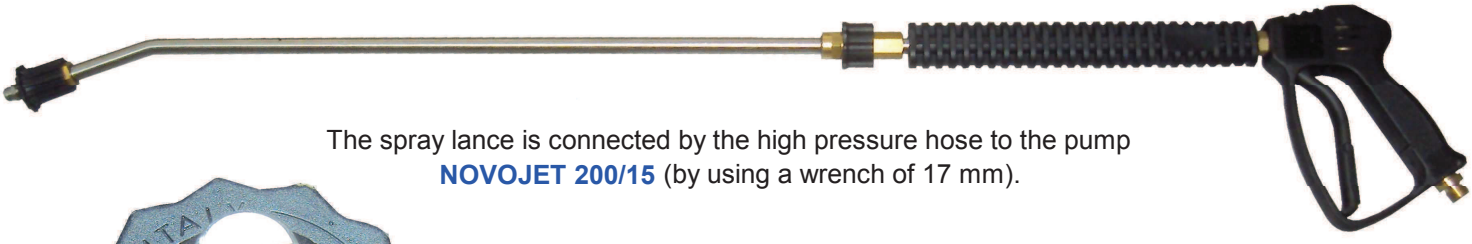


High pressure output towards the spray lance with quick connector

Hose tip of spray lance to connect



High pressure hose (10 mt.)



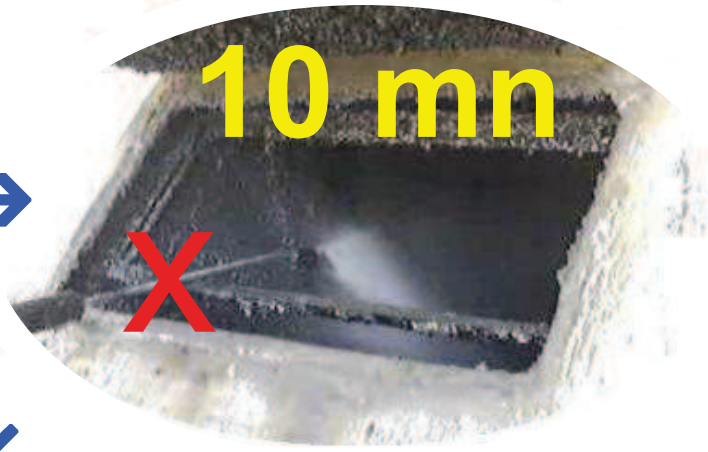
The spray lance is connected by the high pressure hose to the pump **NOVOJET 200/15** (by using a wrench of 17 mm).

The spray nozzle must be adjusted to obtain a jet with the greatest intensity even during the initial cleaning (during this phase, the operator can distance the nozzle to spray a more diffuse).
The spray angle of the nozzle of 15 ° allows a perfect concentration of the jet of **LUBRICLEAN EP** on the working flanks during cleaning.

Attention: after cleaning, do not forget to remove the residual pressure with the gun trigger before disconnecting the hose from the high pressure pump.

Gear set while operating
(with a low load)

200 bars (or 2900 psi)
by 12 to 16 liters per minute



no spray

200 bars (or 2900 psi)
by 12 to 16 liters per minute

If necessary, the finishing phase :
200 bars (or 2900 psi) at low speed

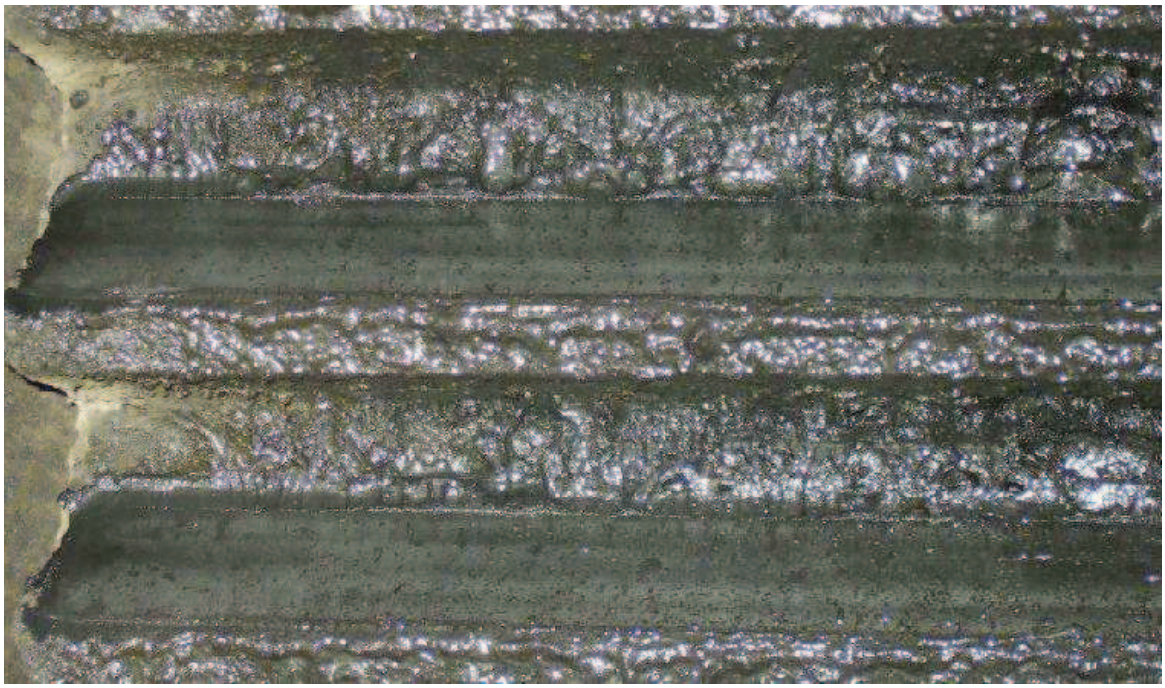
Summary of time and consumption of LUBRICLEAN EP
(times and amounts are estimated for a pump with a flow rate of 15 liters per minute):

- First spray : 8 minutes, 120 liters
- Impregnating : 8 to 10 minutes, no consumption
- High pressure cleaning : 18 to 23 minutes (if one or two pinions) : 270 to 345 liters
- Finishing spray : 5 minutes for each pinion : one or two times 75 liters

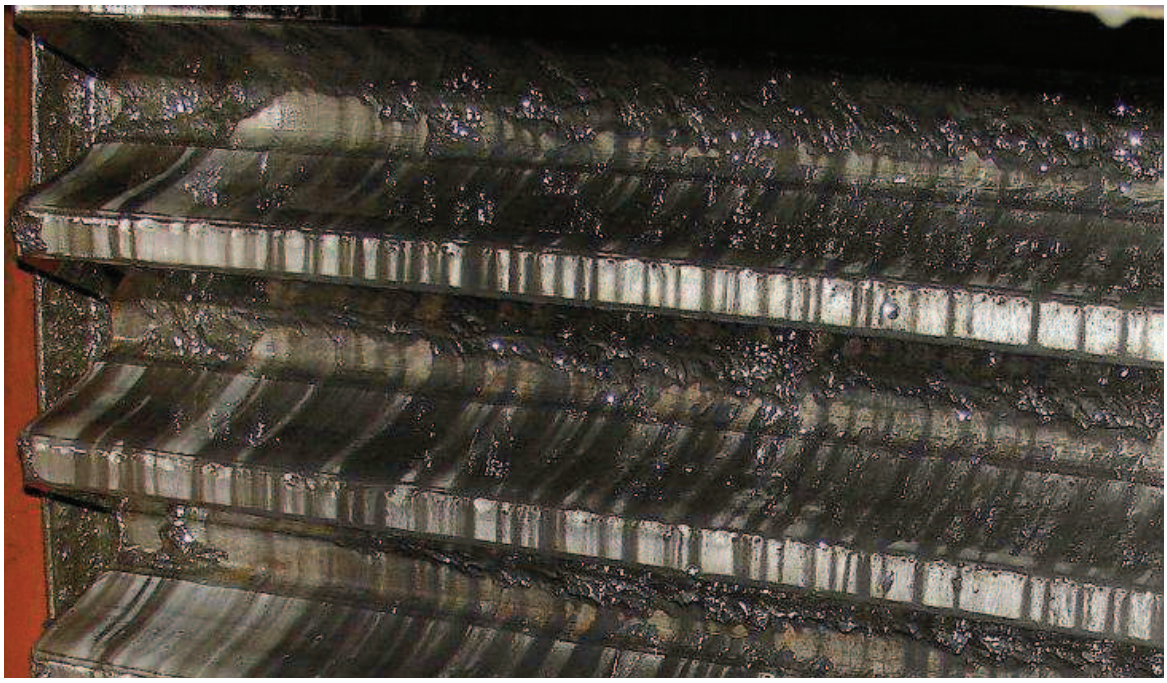
Results:
The open gear set and a very large part of the interior of the housing are cleaned in 1 hour maximum.

LUBRICLEAN EP : PSP Open Loop Mill : Cement plant

Example cleaning done while operating on an open gear, cement mill PSP, double drive (module : 30; $Øp_2$: 7046 mm; b_2 : 710 mm; z_2 : 234).
Spraying by the inspection door, IN pinion side.
Operation carried out during 45 minutes with three drums of **LUBRICLEAN EP** (3 x 180 kg).



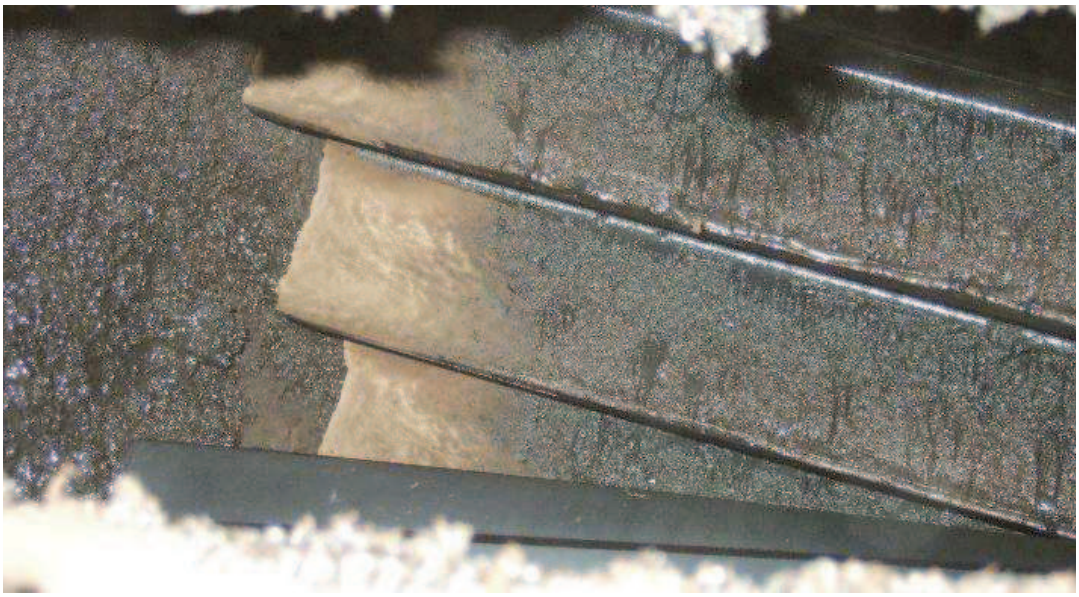
before cleaning (girth gear)



45 minutes after (before finishing)

LUBRICLEAN EP : POLYSIUS SAG Mill : Iron mine

Example cleaning done while operating on an open gear SAG mill POLYSIUS, single drive (module : 30 ; b_2 : 508 mm ; z_2 : 372).
Spraying by the inspection door, OUT pinion side.
Operation carried out during 45 minutes after the complete procedure (finishing for 5 min, slow speed).

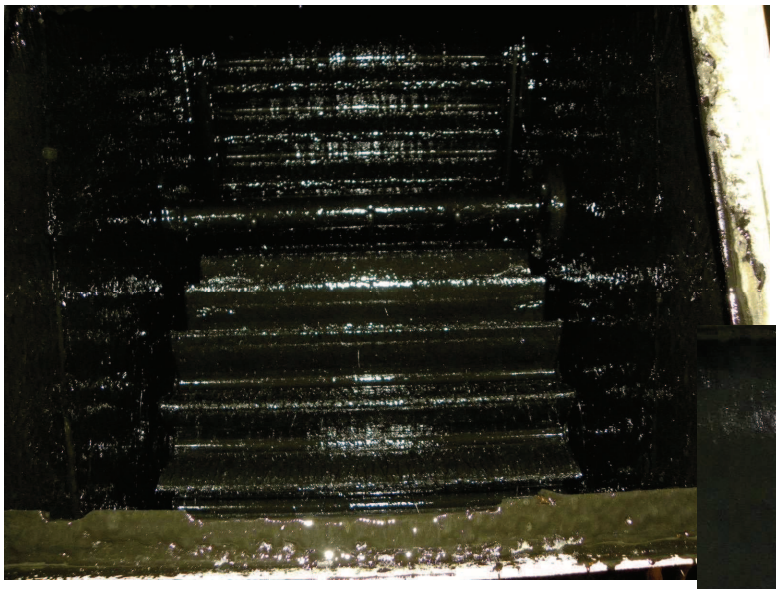


before cleaning

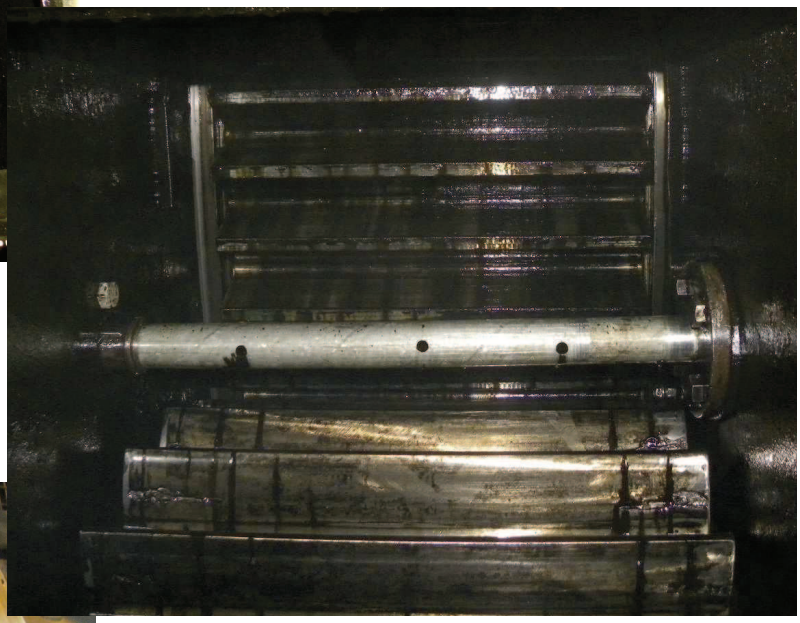
45 minutes after

LUBRICLEAN EP : POLYSIUS Cement Mill : Cement plant

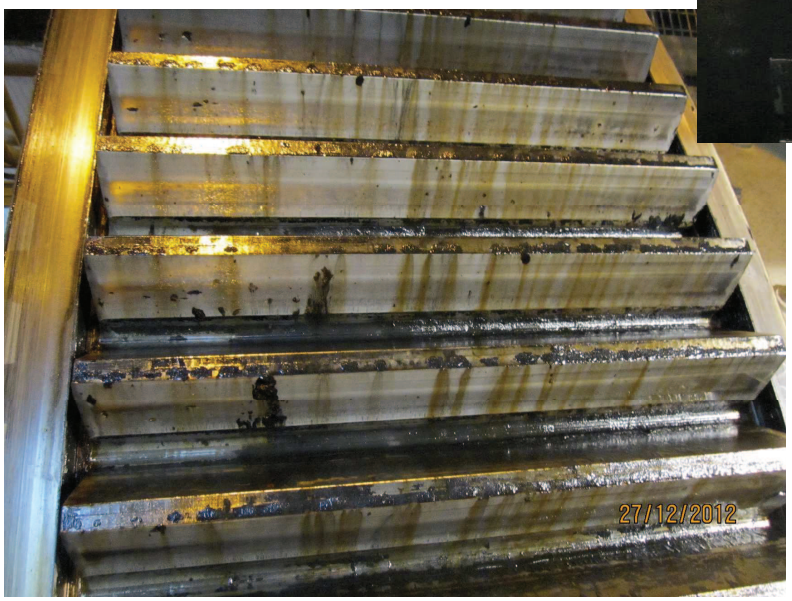
Example cleaning done while operating on an open gear mill POLYSIUS, double drive.
Spraying by the inspection door, IN pinion side.
Operation carried out during 45 minutes after the complete procedure (finishing for 5 min, slow speed, IN and OUT pinion side).
3 **LUBRICLEAN EP** drums (3 x 180 kg).
After cleaning and gear set repair, **running-in with GRAFOLOG R FLUID** (2 x 180 kg, one month).



Pinion before while operating cleaning



Pinion 30 minutes after (before finishing)



Girth gear after 45 minutes with **LUBRICLEAN EP** (after finishing)

Open gear drive while operating cleaning worksheets

The following worksheets are intended to indicate the steps of a cleaning operation with the **LUBRICLEAN EP** of large open gear drives of rotary drum.
The worksheets correspond to the three industrial lubrication methods:

- **Splash lubrication (direct or indirect),**
- **Circulation lubrication or**
- **Spray lubrication (automatic or manual).**

Warning:
The spray cleaning is recommended for an open gear set protected by housing. In the case of the open gear set is "open", not protected by housing, specific safeguards should be implemented to protect the open gear set environment against projections specific to the method of high pressure cleaning.

Note:
For any additional information please contact our Technical Department (especially for machines difficult to stop like kilns).

LUBRICLEAN EP cleaning worksheets:

1 - Cleaning preparation

2 - While operating cleaning

Cleaning worksheets : Preparation - 1/3

Fast cleaning by manual spraying: LUBRICLEAN EP

LUBRILOG CLEANING LUBRICANT			CHARACTERISTICS						
name	nature	structure	40°C viscosity (mm²/s)	4 balls welding (daN)	flash point (C°.)	colour	copper corrosion	V.O.C. contents (*)	bio-degradability
LUBRICLEAN EP	esters	vegetable solvent	2,95	> 500	130	amber	1 b	without	**> 95 %**

(*): Volatile Organic Compounds

Cleaning procedure : preparatory elements

Step	Action or element to implement	Note
1	documents of risk prevention and safety	the various documents required are defined with the plant where the intervention takes place
2	power supply: three-phase 380 V, 50 Hz	the power supply to be used is determined by the high pressure pump used
3	lighting, rags, waste recovery (excluding **LUBRICLEAN EP**)	good quality of lighting is required and directed towards the visit trap chosen for intervention
4	supply **LUBRICLEAN EP**	the amount of **LUBRICLEAN EP** is defined depending on the goal of cleaning (anti-abrasion prevention or pre-mechanical intervention), the size of the open gear drive, the number of pinions, the dirt level of the open gear set and the service lubricant used (usually **two to four 180 kg drums**); it is very important to know the flow of the high pressure pump to set the amount of **LUBRICLEAN EP** that will be consumed during the first two stages and maintain sufficient solvent for the finishing stage; consult our technical department
5 ⚠	preparation of the stop of the lubrication system	except for the splash lubrication, technical services plant should anticipate the stop of lubrication system **without stopping the rotation of the open gear drive** at the start of cleaning

Cleaning worksheets : Preparation - 2/3

Fast cleaning by manual spraying: LUBRICLEAN EP

Cleaning procedure : preparatory elements (continued)

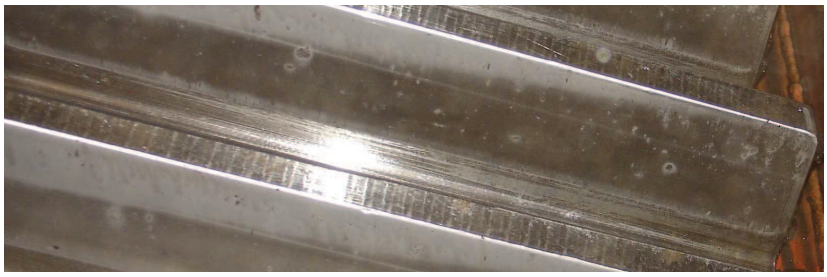
Step	Action or element to implement	Note
6	implementation and connection of the on-drum pump, the high pressure pump and the spray lance	pumps and **LUBRICLEAN EP** drums will be positioned to allow easy use of the spray lance (hose length between the outlet of the high pressure pump and the nozzle is 10 meters); nevertheless check of the hose length is required before cleaning; the connections between the different elements are described on pages 7, 8, 9 and 10 of this document
7	implementation of waste lubricant tanks	the recovery of the mixture "**used lubricant & LUBRICLEAN EP**" must be planned depending on the position of the machine, access, the lubrication system and volumes to recover; in fact, for splash and circulation lubrication methods, the load recovering lubricant is greater than for a spray lubrication
8	reducing of the load of material treated	if possible, reduce the load of the treated material in the rotating tube to reduce the forces applied on the working flanks of the open gear set
9	prime the high pressure pump with the hand pump on drum	the on-drum hand pump should be left in place during cleaning and allow the cane diver to pump the **LUBRICLEAN EP** at the bottom of drum; however, it must be removed quickly when the drum is empty to ensure the continuity of the spray.
10	equipment for spray operator	the operator responsible for spraying must be equipped with the usual PPE (personal protective equipment) and adapted against huge projections of **LUBRICLEAN EP** (especially when the cleaning is done by the OUT pinion); face shield, gloves, mask, goggles and waterproof combination are required

Cleaning worksheets : Preparation - 3/3

Fast cleaning by manual spraying: LUBRICLEAN EP

Cleaning procedure : preparatory elements (continued)

Step	Action or element to implement	Note
11	check the timing equipment and communication with the spray operator	the control of time is required for the various steps of while operating cleaning; it is essential to maintain sufficient **LUBRICLEAN EP** for possible finishing stage
12	check the means of communicating with the control room	the communication with the control room of the machine is required in order to stop the rotation of the machine after cleaning or to restore the lubrication (if this is possible in use)
13	opening the inspection door chosen for cleaning operation	
14	spray test with the **LUBRICLEAN EP**	before stopping the lubrication, the spraying should be tested; **during the whole process the spraying is carried out at high pressure**
15	setting of the safety tether	the adjusting of the tether is used to prevent contact of the spray lance and the open gear set in service; the minimum distance is approximately 200 mm from the working flanks to be cleaned; sometimes the pinion position does not allow such an approach; cleaning is less effective in this case; the tether can be attached to the gun grip of the spray lance and the handrail around the machine, for example



Cleaning worksheets : Cleaning - 1/3

Fast cleaning by manual spraying: LUBRICLEAN EP

Cleaning procedure : while operating cleaning

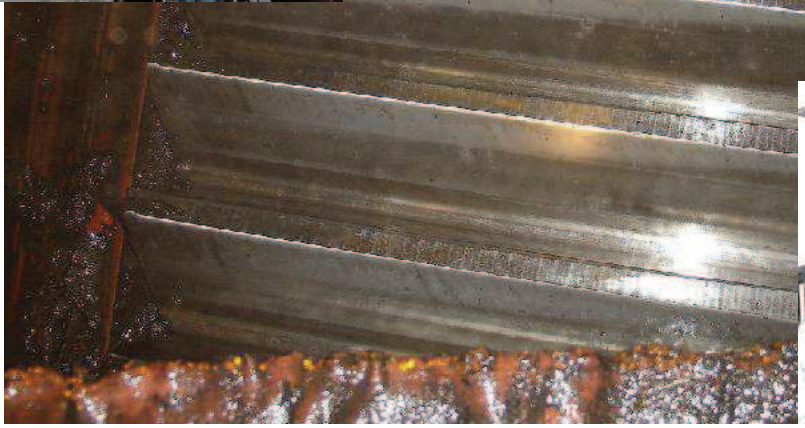
	Step	Gear set position	Action	Note
STEPS 1 - 2 - 3 TO SIMULTANEOUSLY	1	In-service	**shutdown** of the open gear drive **lubrication system**	complete stop in case of a spray or circulation lubrication
	2	In-service	bottom **opening** of the housing	the bottom opening of the housing allows the emptying of the lubricant in case of splash or circulation lubrication ; in case of a spray lubrication, the used lubricant is normally discharged freely or cleaned regularly by the lubrication department
	3	In-service	**impregnating :** **spray LUBRICLEAN EP** during around **8** minutes at **200 bar** consumption: 120 liters at a rate of 15 l / min	spraying is carried out at a distance greater than 500 mm from surfaces to be cleaned by the inspection trap of the pinion selected for the operation; the **LUBRICLEAN EP** jet will be more diffused; we do not recommend to change the high pressure or the opening angle of the jet nozzle during this phase for a matter of ease of action; **note :** by **splash** lubrication, the impregnation can be done by adding one drum of **LUBRICLEAN EP** (180 kg) to the bath tank before the emptying on step 2;in which case, let turn the rotary drum for 1 to 3 hours depending on fouling
	4	In-service	**stop spraying LUBRICLEAN EP** during around **10 minutes**	it is possible to close the visit trap for the 10 minutes off
	5	In-service	**high pressure cleaning :** **spray LUBRICLEAN EP** during around **18 or 23** minutes at **200 bar** consumption: 270 or 345 liters at a rate of 15 l / min	the presence of one or two pinions determines the while operating cleaning time of open gear drive; in fact it is important to keep enough **LUBRICLEAN EP** for the finishing phase

Cleaning worksheets : Cleaning - 2/3

Fast cleaning by manual spraying: LUBRICLEAN EP

Cleaning procedure : while operating cleaning (continued)

Step	Gear set position	Action	Note
6	Stop	**stop** the machine at the end of step 5 **Caution: It is very important to ask to stop the machine as soon as possible when the cleaning ends because the lubrication is stopped;** **if the machine is not stopped, lubrication must be restored the soonest possible**	In all cases we recommend to stop the machine, to control the quality of cleanness and working flanks of the open gear set (when the operation of the machine permits); in case of a preventive cleaning against abrasion, the machine can restart but working flanks must be covered by lubricant in big amount (like during an initial priming) or be sprayed set continuously for around 4 hours (when the lubrication method is spraying); in case of splash or circulation lubrication, the fresh lubricant must be installed in a clean bath tank.



Cleaning worksheets : Cleaning - 3/3

Fast cleaning by manual spraying: LUBRICLEAN EP

Cleaning procedure : while operating cleaning (continued)

Step	Gear set position	Action	Note
7	Auxiliary drive	**high pressure finishing:** **spray LUBRICLEAN EP** during around **5** minutes for each pinion at **200 bar** **Nota bene :** in case of two drive pinion must be cleaned, the high-pressure cleaning system has to be moved for spraying by the second inspection trap consumption: one or two times 75 liters at a rate of 15 l / min	this finishing phase is imperative before has to be done any mechanical intervention cleaning; however, the requirements of mechanical operations (which have to be performed) and the level of cleanliness obtained (after step 5) as well, define whether the finishing phase is necessary or not; **Caution : spraying is carried out on the pinions but also on the girth gear whose root teeth should be thoroughly cleaned (result difficult to obtain especially for fast rotary drums while operating)**
8	Stop	**stop** the machine at the end of step 7 **manual finishing** cleaning if necessary	manual finishing is to be anticipated (for open gear set and inside the housing) but it will be greatly facilitated by the impregnation of residual lubricant by the **LUBRICLEAN EP**; **LUBRICLEAN EP** protective film covers the teeth and prevents the auxiliary drive rotation from creating rish of damages on working flanks

Warning:
At the end of the while operating cleaning, **the gear set is no longer lubricated**.
It is therefore vital **to stop the machine quickly**. If it is not planned or possible to stop, it is mandatory **to put lubrication in service again** immediately after the end of **LUBRICLEAN EP** spraying (in case where lubrication system can be restored while operating).

LUBRICLEAN EP

Version 28.07.2009

TECHNICAL DATA SHEET

DESCRIPTION

LUBRICLEAN EP is a « green » solvent which needs no « Danger » labelling and issued from vegetable chemistry.
LUBRICLEAN EP is certified without chlorine, aromatics and none VOC (volatile organic compounds).
After application on surfaces to be cleaned, **LUBRICLEAN EP** evaporates slowly at ambient temperature and leaves a thin oily film with extreme pressure properties. The film is easily emulsifiable with water if complete degreasing is required.

TYPICAL APPLICATIONS

LUBRICLEAN EP scours and cleans, during running under heavy loads, the dirty metallic surfaces covered by hydrocarbons and petrol cockefied residues as calcined lacquer such as :
- All size chains.
- Open gears.
- Cables and racks gearing.

LUBRICLEAN EP can be used by average pressure spray gun on metallic parts which are to be treated on the temperature range of 20 to 60 C°.

TECHNICAL CHARACTERISTICS

PROPERTIES	VALUES	UNITS	STANDARDS
Vegetable synthetic solvent	Esters		
Colour	Amber		
Viscosity at 40 C°	2.95	mm²/s	ASTM D 445
Flash point	130	C°	ASTM D 92
Corrosion (copper)	1 b	Quotation	ASTM D 130
4 ball welding	> 500	daN	ASTM D 2596
VOC contents	0	%	DIN 14 000
Biodegradability	> 95	%	CEC L-33-A-93

LUBRILOG S.A. ZI des Chasses, 18, rue Nicolas Appert, B.P. 60261, 26106 ROMANS SUR ISERE cedex, FRANCE
Tel: +33 (0)4.75.45.26.00 - Fax: +33 (0)4.75.45.18.65 - Web : www. lubrilog.com - Email : contact@lubrilog.fr

LUBRICATION ENGINEERING

LUBRILOG

LUBRILOG SA
Z.I. des Chasses - 18 rue Nicolas Appert - BP 60261 - F. 26106 Romans Cedex
T : +33 (0)4 75 45 26 00 - F : +33 (0)4 75 45 18 65 - e-mail : contact@lubrilog.fr

WWW.LUBRILOG.FR