Grinder – 30005 Open Channel Series

EN Installation, Operating and Maintenance Instructions

www.sulzer.com

Rev. E
EN: Declaration of Conformity
DE: Konformitätserklärung
FR: Déclaration de Conformité
ES: Declaración de Conformidad
IT: Dichiarazione di conformità
NL: Overeenkomstigheidsverklaring
SV: Försäkran om överensstämmelse
NO: Samsvårserklmring
FI: Vaatimustenmukaisuusvakutus
RU: Заявление о соответствии

EN: Manufacturer/ Address:
DE: Hersteller / Adresse:
FR: Fabricant / Adresse:
ES: Fabricante / Dirección:
IT: Costruttore / Indirizzo:
NL: Fabrikant / Adres:
SV: Tillverkare / Adress:
NO: Produsent / Adresse:
FI: Valmistaja / Osoite:
RU: Изготовитель / Адрес

JWC Environmental / Unit 15, Daneside Business Park, River Dane Road, Congleton, Cheshire CW12 1UN
United Kingdom

EN: Name and address of the person authorised to compile the technical file to the authorities on request:
DE: Name und Adresse der Person, die berechtigt ist, das technische Datenblatt den Behörden auf Anfrage zusammenzustellen:
FR: Nom et adresse de la personne autorisée pour compiler le fichier technique auprès des autorités sur demande:
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IT: Il nome e l’indirizzo della persona autorizzata a compilare la documentazione tecnica per le autorità:
NL: Naam en adres van de persoon die geautoriseerd is om het technisch bestand te samen te stellen voor de autoriteiten:
SV: Namn och adress på den person som är auktoriserad att på begäran utarbeta den tekniska dokumentsamlingen:
NO: Navn og adresse på den personen som har tillatelse til å sette sammen den tekniske filen til myndighetene ved forespørsel:
FI: Viranomaisten vaatiessa tekninen lomakkeen valtuutettu laatijan nimi ja osoite:
RU: Ф.И.О и адрес лица, уполномоченного составлять техническую документацию по требованию органов власти:

Frank Ennenbach,
Director Product Safety and Regulations,
Sulzer Management AG,
Neuwiesenstrasse 15,
8401 Winterthur,
Switzerland.

EN: Declare under our sole responsibility that the products:
DE: Erklärt eigenverantwortlich, daß die Produkte:
FR: Déclarons sous notre seule responsabilité que les produits:
ES: Declaramos bajo nuestra exclusiva responsabilidad que los productos:
IT: Dichiariamo sotto la nostra esclusiva responsabilità che i prodotti:
NL: Verklaren geheel onder eigen verantwoordelijkheid dat de produkten:
SV: Forsäkrar under eget ansvar att produkterna:
NO: Erkherer pa eget ansvar, at følgende produkter:
FI: Vakuutamme yksinomaan omalla vastuullamme, että seuraavat tuotteet:
RU: Заявляем со всей полнотой ответственности, что изделия:

EN: Grinder – Inline Series
DE: Zerkleinerer - Serie für Rohrleitungen
FR: Broyeur - Broyeur - Gamme en ligne
ES: Triturador en línea
IT: Trituratore – serie flangiata
NL: versnijdend
SV: Avloppskvarn - inlineutförande
NO: Avløpskvern – type inline
FI: Silppuri – inline mallit
RU: Дробилка фланцевой серии


ES: Como se establece en Directiva submergimaria 2006/42/EC, Directiva EMC 2004/108/EC, Directiva sobre bajo voltaje 2014/35/UE, Directiva sobre el ruido 2000/CE enmendada por 2005/88/CE.


EN ISO 12100-1, EN ISO 12100-2

Gregory B. Queen
VP Global Operations
JWC ENVIRONMENTAL INC
04-12-2019
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ATEX Warning Statements

1. Where a grinder is to be installed in a potentially explosive atmosphere ensure that this has been specified at the time of purchase and that the equipment has been supplied accordingly and displays an ATEX nameplate or is supplied with a certificate of conformity. If there is any doubt as to the suitability of the equipment please contact Sulzer before commencing with installation and commissioning.

2. Process liquids or fluids must be kept within -20°C – 40°C, otherwise the surface of grinder or system components may become an ignition source due to temperature rises. Where the process liquid temperature is less than 90 ºC the maximum surface temperature will not exceed 90 ºC provided the grinder is installed, operated and maintained in accordance with this manual.

3. Cavities that could allow the accumulation of explosive gases have been designed out of the system. However, any accumulation of gases or material should be fully purged before any work is carried out on the grinder or system. The grinder should not be operated without liquid influent and no ignition sources to be present.

4. Electrical installation and maintenance work should only be carried out by suitably qualified and competent persons and must be in accordance with relevant electrical regulations.

5. If there is a risk of an accumulation of explosive gases or dust, proper ventilation must be performed, removing all gases and dust.

6. When fitting drives, couplings, and guards to a grinder unit it is essential that these are correctly fitted, aligned and adjusted in accordance with the installation instructions. Failure to do so may result in sparking due to unintended mechanical contact, or temperature rises due to mechanical or electrical overload.

7. Failure to operate or maintain the grinder and ancillary equipment in line with the manufacturer’s instructions may lead to premature and potentially dangerous failure of components. Regular inspection, and where necessary, replacement of bearings, seals, other wearing parts and lubrication is essential.

8. The grinder and its components have been designed to ensure safe operation within the guidelines covered by legislation. Accordingly, Sulzer has declared the machine safe to use for the duty specified as defined by the Declaration of Conformity that is issued with this instruction manual and the conditions as specified in the Limitation of Use. The use of replacement parts that are not manufactured by or approved by Sulzer may affect the safe operation of the grinder and it may therefore become a safety hazard to both operators and other equipment. In these circumstances the Declaration provided will become invalid. The guarantee referenced on the Terms and Conditions of Sale will also be invalidated.
Nameplate Details

SULZER CONFIDENTIAL
Safety and Hazard Warnings

Presence of dangerous voltage.

Non-compliance may result in personal injury.

Lock out – Tag out notification

Follow lockout procedures before connecting / removing supply power.

Electrical connection should only be made using equipment suitable for both rating and environment. Where any doubts exist regarding the suitability of equipment, Sulzer should be consulted before proceeding.

Earthing points will be provided on electric drives (if supplied) and it is essential that these are correctly connected. The electrical installation should include appropriate isolating equipment to ensure that the grinder, drive and motor, or grinder motor is safe to work on.

By the nature of the equipment and its operating environment the grinder can be an extremely dangerous machine. It is vital that operators are conversant with these Installation, Operation and Maintenance Instructions prior to working with the machine.

When servicing the grinder, be certain that the mains isolator is off and padlocked. Serious injury could result from accidental start-up.

Keep clear of rotating components.

NEVER inspect/work on or near the cutter chamber without first isolating and locking the grinder.

Auto-restart of rotating components may occur after power loss if the main isolator is not off.

During installation and maintenance, attention must be paid to the safe handling of all items. Where a grinder or its components weigh in excess of 20 kg (45 lb) it is required that suitable lifting tackle should be used to ensure that personal injury or damage to components does not occur.

Suspended load. Do not stand under the grinder during installation / removal.

Relieve line pressure before opening pipe flanges.

Wear safety shoes when handling components.

Sharp edges. Wear safety gloves when handling grinder cutters and spacers.

Wear eye protection when cleaning components.
All electrical equipment, including control and safety devices, should be suitably rated for the environment in to which they are installed.

To minimise the risk of sparking or temperature rises due to mechanical or electrical overload the following control and safety devices should be fitted. The control system will shut the grinder down if the motor current or temperature exceed specified limits or a jam of the cutter stack occurs. This includes a system that reverses the machine in order to clear any such jam. An isolator switch will disconnect all electrical supply to the motor and ancillary electrical equipment and is capable of being locked in the OFF position. All control and safety devices must be fitted, operated and maintained in accordance with the manufacturer’s instructions.

The grinder must rotate in the correct direction for proper operation. This must be checked on installation and commissioning and after any maintenance has been carried out. Failure to observe this may lead to mechanical or electrical overload.
GENERAL INFORMATION

The grinder reduces solids in sewage (Figure 1). A separate control panel provides grinder controls.

<table>
<thead>
<tr>
<th>Model</th>
<th>Cutter Stack Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30005-0012</td>
<td>300</td>
</tr>
<tr>
<td>30005-0018</td>
<td>450</td>
</tr>
<tr>
<td>30005-0024</td>
<td>600</td>
</tr>
<tr>
<td>30005-0032</td>
<td>800</td>
</tr>
<tr>
<td>30005-0040</td>
<td>1000</td>
</tr>
<tr>
<td>30005-0060</td>
<td>1500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight (Kg)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>30005-0012</td>
<td>140</td>
</tr>
<tr>
<td>30005-0018</td>
<td>155</td>
</tr>
<tr>
<td>30005-0024</td>
<td>185</td>
</tr>
<tr>
<td>30005-0032</td>
<td>225</td>
</tr>
<tr>
<td>30005-0040</td>
<td>265</td>
</tr>
<tr>
<td>30005-0060</td>
<td>338</td>
</tr>
</tbody>
</table>

*less drive

Drive Assembly Weights (kg)

<table>
<thead>
<tr>
<th></th>
<th>Reducer Only</th>
<th>Motor Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP 55 2.2</td>
<td>4.0</td>
<td>2.2</td>
</tr>
<tr>
<td>IP 68 31</td>
<td>36</td>
<td>38</td>
</tr>
<tr>
<td>IP 55 2.2</td>
<td>4.0</td>
<td>2.2</td>
</tr>
<tr>
<td>IP 68 32</td>
<td>44</td>
<td>84</td>
</tr>
<tr>
<td>IP 55 2.2</td>
<td>4.0</td>
<td>2.2</td>
</tr>
<tr>
<td>IP 68 32</td>
<td>44</td>
<td>84</td>
</tr>
<tr>
<td>IP 55 2.2</td>
<td>4.0</td>
<td>2.2</td>
</tr>
<tr>
<td>IP 68 32</td>
<td>44</td>
<td>84</td>
</tr>
</tbody>
</table>

Limitation of Use

Limits of the Machine

<table>
<thead>
<tr>
<th>Description</th>
<th>Twin-shafted grinder with cutters and spacers enclosed in a cast iron housing meeting various standards, speed reducer, electric motor and motor controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intended Use</td>
<td>Particle size reduction of municipal / industrial sewage waste</td>
</tr>
</tbody>
</table>
| Maximum Flow Rate | 30005-0012 – 141 m³/hr  
30005-0018 – 223 m³/hr  
30005-0024 – 311 m³/hr  
30005-0032 – 477 m³/hr  
30005-0040 – 686 m³/hr  
30005-0060 - 1277 m³/hr |
| Maximum Process Pressure | 4.7 metres water column                                                                                                               |
### Installation, Operating and Maintenance Instructions

#### Personnel Information

<table>
<thead>
<tr>
<th>Anticipated Level of Training, Ability &amp; Experience</th>
<th>Applicable local, federal and area safety rules, regulations and guidelines; discipline-specific apprenticeship/training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Physical Requirements</td>
<td>N/A</td>
</tr>
<tr>
<td>Personnel Affected</td>
<td>Installers, electricians, operators, maintenance personnel</td>
</tr>
</tbody>
</table>

#### Environmental Limits

| Temperature | Operation: -5°C to +40°C  
|            | Storage: -40°C to +65°C   |
| Humidity    | IP66                                                                   |
| Elevation   | 3048 metres above sea level |

#### Space Limits

| Space Requirements | Grinder: 483mm x 305mm x 1041mm  
|                    | Controller: 457mm H x 406mm W x 254mm for IP66 enclosure |
| Clearance Required for Operation | 150mm over motor fan cover  
|                                   | 914mm in front of controller |
| Clearance Required for Maintenance | 610mm above  
|                                   | 914mm on left or right side of grinder  
|                                   | 914mm in front of controller |

#### Interface Limits

| Electrical | 120V/1PH/60HZ to 575V/3PH/60HZ  
|           | 220V/1PH/50HZ to 400V/3PH/50HZ |
| Water     | N/A                                 |
| Hydraulic | N/A                                 |
| Connection to Other Equipment | Two (2) dry-contact relays indicating grinder Run and Fail conditions for remotely located monitoring operation powered by foreign sources |
INSTALLATION

Inspection & Safety Recommendations

In common with other items of process plant a grinder must be installed correctly to ensure satisfactory and safe operation. The grinder must also be maintained to a suitable standard. Following these recommendations will ensure that the safety of personnel and satisfactory operation of the grinder is achieved.

When handling harmful or objectionable materials, adequate ventilation must be provided in order to disperse dangerous concentrations of vapours. It is recommended that wherever possible, Sulzer grinders should be installed with provision for adequate lighting, thus ensuring that effective maintenance can be carried out in satisfactory conditions. With certain product materials, a hosing down facility with adequate draining will simplify maintenance and prolong the life of grinder components.

System Design & Installation

At the system design stage, consideration must be given to provision of filler plugs, and the installation of non-return and/or isolating valves where applicable.

Handling

During installation and maintenance, attention must be paid to the safe handling of all items. Where a grinder or its components weigh in excess of 20 kg (45 lb) it is recommended that suitable lifting tackle should be used to ensure that personal injury or damage to components does not occur.

Do not attempt to lift the grinder using only one lifting point. Extreme caution should be observed for personnel safety when lifting heavy objects.

By design the cutters have sharp edges. Great care must be taken when handling. The use of protective gloves is recommended.

STORAGE

Grinders are dispatched from our factory with the cutter chamber sprayed with a moisture repellent coating and ready for immediate installation and operation.

Should the machine be stored or left stationary for any length of time it is recommended that the cutter stack is re-sprayed with anti-rust lubricant and that the shafts are rotated monthly.

Failure to do this may result in a higher frequency of reversals and in extreme cases the machine to seize due to the tight running clearances of the individual cutting elements during commissioning and initial start-up.

The controller should be stored in a controlled dry environment to prevent moisture buildup causing corrosion of contactors and other metallic components.
The grinder is protected by a PLC control unit set to the correct operating philosophy. Only PLCs supplied or approved by Sulzer should be used. Failure to observe this requirement may cause premature machine failure and could invalidate the warranty of the machine. It is also important that the PLC be correctly wired into the panel.

Before installing the grinder please ensure that all plugs and inspection plates are replaced.

Electrical

Electrical connection should only be made using equipment suitable for both rating and environment. Where any doubts exist regarding the suitability of equipment, Sulzer should be consulted before proceeding.

Earthing points will be provided on electric drives (if supplied) and it is essential that these are correctly connected. The electrical installation should include appropriate isolating equipment to ensure that the grinder and drive assembly is safe to work on.

General safety

All guards and removable. Maintain-in-place covers must be in place and securely fitted while the machine is running.

All nuts and bolts, securing flanges and base mounting fixtures must be checked for tightness before operation.

If, when starting, the grinder does not appear to operate correctly, it must be shut down immediately and the cause of the malfunction established before operations are recommenced.

May contain substances from the ECHA SVHC Candidates List (REACH - Regulation (EC) No. 1907/2006).

Guards

In the interests of safety, all guards must be replaced after necessary adjustments have been made to the grinder.

WARNING / CONTROL DEVICE

Prior to operating the grinder, if any warning or control devices are fitted, these must be set in accordance with their specific instructions.

Rotate grinder drive motor 1-5 minutes every 3 months if stored either by hand or by applying power to the motor. Check for grinder drive lubricant leakage. Contact Sulzer if leakage exceeds 6ml.
Sulzer is not liable if local or international regulations are not followed or for damage caused by wiring errors or improper shielding. Use lifting equipment rated for the weight of the grinder minimum attached to all the grinder top cover lifting rings as shown to lift the grinder. Verify the grinder flow arrows, located on the side of the grinder, point in the direction of flow.

Prior to installation/commissioning:

- Check external hardware as gasketed areas may have a tendency to loosen fasteners. Retighten if loose.
- Check paint for any slight damage and touch up if necessary. Standard Sulzer colour (RAL 5002).

Use anchor bolts (not provided) of suitable size and type for the installation site for attaching the frame to the channel. Fill any gaps between the frame and channel wall.

NOISE LEVELS
The sound pressure level will not exceed 70 dB at one metre distance from the grinder. This is based on a typical installation and does not necessarily include noise from other sources or any contribution from building reverberation.

EXPLOSIVE PRODUCTS / HAZARDOUS ATMOSPHERES
In certain instances the product being pumped may well be of a hazardous nature. In these installations consideration must be given to provide suitable protection and appropriate warnings to safeguard personnel and plant.

LUBRICATION
At 10,000 hr intervals, bearings, gears and seal assembly inspection should take place along with gear grease replenishment.

Under tropical or other arduous conditions, however, more frequent lubrication may be necessary. It is therefore advisable to establish a suitable maintenance schedule or periodic inspection to match service conditions.

Open channel grinders should be isolated from flow prior to servicing.

Figure 2 Grinder Installation
START-UP PROCEDURE

By the nature of the equipment and its operating environment the grinder can be an extremely dangerous machine. It is vital that operators are conversant with these Operation and Maintenance Instructions prior to working with the machine.

Verify there is no unauthorized personnel or materials near the grinder.

Use a control panel rated for the grinder motor voltage, amps, frequency with a suitable power disconnect and overtemp protection if the motor has a thermostat.

Apply power to grinder with the control panel control switch.

Check for proper motor or shaft rotation (Figure 3). Disconnect power and interchange any two motor leads if reversed. Gradually apply flow. Verify reduction of solids.

Where applicable:
1. Check all installation hardware once the machine is installed in its correct operating position.
2. Check all electrical connections for continuity and earthing and that installation is in accordance with relevant regulations and circuit diagrams.
3. Always ensure that machine is guarded in accordance with PD5304: 2000 Safety of Machinery requirements before any attempt is made to operate.
4. On start-up check the direction of rotation of the cutters. The cutters should rotate towards the centre when viewed from the inlet side.
5. Check that the grinder stops when the stop operation is activated.
6. Start up the machine and gradually start the feed system to the machine. Care should be taken not to overburden the machine. Adjust feed to maintain only the smallest practical reservoir of material in cutter stack.
7. After a further 10 minutes of running, stop the machine, switch off and lock the main isolator. Check the tightness of all securing bolts. Recheck every 500 hours of operating time.
8. Check the tightness of all cables and connections. Re-check every 500 hours of operating time.
9. Observe manufacturer’s guidelines with regard to gearbox lubricant initial renewal and subsequent intervals.
10. In the event of machine overload (jam), the controller is programmed to activate the following procedure:-
   I. Momentarily reverse rotation to clear the condition, then return to normal operation.
   II. If overload re-occurs within 60 seconds, reverse rotation to clear the condition, then return to normal operation.
III. If a third overload occurs within 60 seconds of the first, machine shuts down and energises an alarm circuit.

11. After machine shutdown, relieve pressure, isolate, and lock off. Inspect machine, remove any obstruction and reset the controller.

12. The machine can now be re-started.

⚠️ NEVER inspect or work on or near the cutter chamber without first isolating and locking the machine.

**Use of items not approved or manufactured by Sulzer**

The grinder and its components have been designed to ensure that the grinder will operate safely within the guidelines covered by legislation. As a consequence, Sulzer has declared the machine safe to use for the duty specified as defined by the Declaration of Conformity that is issued with this instruction manual.

The use of replacement items that are not approved by or manufactured by Sulzer may affect the safe operation of the grinder and it may therefore become a safety hazard to both operators and other equipment. In these instances the declaration provided will therefore become invalid. The guarantee referenced in the Terms and Conditions of Sale will also be invalidated if replacement items are used that are not approved or manufactured by Sulzer.

**DISMANTLING ADVICE**

⚠️ When servicing the grinder, be certain that the main isolator is tagged out / locked out. Serious injury could result from accidental start-up.

1. Disconnect wiring at motor(s) terminal box(es) and tag leads for identification.
2. Isolate the grinder from influent.
3. If necessary, the grinder may be completely removed from installation using the recommended lifting equipment.
4. Replace the cutter stack with the maintenance screen if required.
5. When dismantling cutters and spacers, take careful note of the position and orientation of each component.

**CLEANING / INSPECTION**

It is important to periodically inspect the grinder (timeframe dependent on usage).

1. Steam clean and disinfect all parts of the unit excluding motor, seal assemblies, gear drive unit and bearings.
2. Remove any gasket material from joint faces.
3. Housings should be cleaned thoroughly.
4. Inspect all parts for excessive wear and replace if necessary.
5. Sealed bearings cannot be re-greased, replace if necessary.
6. Inspect gears for wear and damage and replace if necessary.
7. All cutters and spacers must be clean and free from cracks or excessive wear.

8. Shafts should be clean and any burrs filed off for easier stacking. Inspect shafts for excessive wear of hexagonal portion. Replace if necessary.

RE-ASSEMBLY ADVICE

1. Lubricate all bores, shafts and seals on re-assembly.
2. Lubricate gears on re-assembly with the specified lubricant.
3. Re-connect wiring at motor(s) terminal box(es) using tag leads for identification.
4. Re-open system isolation valves.
5. On completion of assembly, run through the ‘initial start-up’ procedure.

EXTENDED SHUTDOWN

CAUTION – electrical, cutting, lifting risk is possible

Attach lifting equipment and remove the grinder.

Ensure the machine is adequately supported prior to steam cleaning, excluding the drive assembly.

Coat interior and cutters with rust inhibitor.

Place the grinder into storage. See STORAGE.
MAINTENANCE

Remove and lock out supply power.

After first 3 months, then every 6 months or if solids not processed:

- Check cutters for wear, edges should not be rounded. (See Allowable Wear Tolerances.)
- Check cutter stack tightness.

If loose or worn, refer to TROUBLESHOOTING.

Every 6 months add grease to the intermediate yoke assembly (if fitted).

Every 12 months routine maintenance should be carried out.

- Check cutter stack tightness and cutters for wear. (Replace if necessary).
- Remove drive assembly, then remove top and bottom covers. If top or bottom seals housings are contaminated with effluent, replace seals.
- Prior to refitting top and bottoms covers, fit new gaskets.

Every 5 years: (See Figure 4)

- Remove drive assembly, top cover and old grease.
- Inspect gears for damage or wear, replace if necessary, then replenish grease. See Table 1 Lubricants.

Table 1 Lubricants

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Lubricant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gear grease (Do not mix)</td>
<td>500 grams</td>
</tr>
<tr>
<td>Ormskirk</td>
<td>Lithium Complex 559”</td>
</tr>
<tr>
<td>Yoke grease (Do Not Mix)</td>
<td>Spheerol LCX 6002 *</td>
</tr>
<tr>
<td>Castrol</td>
<td></td>
</tr>
<tr>
<td>O-Ring grease</td>
<td></td>
</tr>
<tr>
<td>Ironsides Lubricant Ltd</td>
<td>Silicon Valve Grease* 0250/0077</td>
</tr>
<tr>
<td>Rust inhibitor</td>
<td>SOL-732-0620K Spray”</td>
</tr>
<tr>
<td>Solent</td>
<td></td>
</tr>
<tr>
<td>General and protectant</td>
<td>WD-40 Aerosol Lubricant*</td>
</tr>
<tr>
<td>WD-40 Company</td>
<td></td>
</tr>
</tbody>
</table>

* O.E.M. (Original Equipment Manufacturer)
Allowable Wear Tolerances

<table>
<thead>
<tr>
<th>Part No.</th>
<th>O/D</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>31016</td>
<td>0.20mm MAX</td>
<td>zero wear</td>
</tr>
<tr>
<td>31017</td>
<td>0.63mm MAX</td>
<td>0.75mm per side at edge of cutter. See Figure 5</td>
</tr>
</tbody>
</table>

Troubleshooting

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids not reduced.</td>
<td>Cutter rotation.</td>
</tr>
<tr>
<td></td>
<td>Cutters for wear.</td>
</tr>
<tr>
<td></td>
<td>Cutter stack tightness.</td>
</tr>
<tr>
<td></td>
<td>Grinder motor drive train.</td>
</tr>
<tr>
<td>Loose cutter stack. The unit must be stripped down.</td>
<td>Seal cartridges for damage</td>
</tr>
<tr>
<td></td>
<td>Cutters for wear.</td>
</tr>
<tr>
<td></td>
<td>Lock nuts loose.</td>
</tr>
<tr>
<td>Excessive noise, vibration or reversals</td>
<td>Drive gears for wear.</td>
</tr>
<tr>
<td></td>
<td>Seal cartridges for contamination.</td>
</tr>
<tr>
<td></td>
<td>Cutters for wear.</td>
</tr>
</tbody>
</table>