1 Foreword

1.1 General Instructions

This guide will help you to use the RUD System High Wear-Resistance safely, properly and profitably. When you follow the instructions in this guide, you will

- Increase the reliability and service life of the RUD System High Wear-Resistance and the plant
- Avoid dangers
- Reduce repairs and down times

This guide must

- **Be available at all times at the place of use**
- **Be read and followed by everyone who works on the RUD System High Wear-Resistance**

The RUD System High Wear-Resistance has been manufactured according to the state-of-the-art and in compliance with the recognized safety rules. However, improper handling or use for other than intended purpose may endanger the life and limb of the user or third parties and/or damage the conveyor system and other tangible assets. Spare parts must fulfil the technical requirements specified by RUD Ketten. This is guaranteed in the case of original spare parts, as they are subjected to continuous quality control by a quality management system certified under ISO 9001. Third party spare parts may, under certain circumstances, change the specified design characteristics of the system, and lead to serious defects which, in such a case, would not be the responsibility of RUD Ketten. Use a suitably equipped workshop for performing maintenance work. Only the manufacturer can guarantee to carry out a professional overhaul or repair. This guide has been drawn up with the greatest possible care. However, if you would like further information, please contact:

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1.2 Intended Usage

- The RUD System High Wear-Resistance is a horizontal and ascending conveyor system for bulk materials.
- In stationary operation, the permitted power transfer through the components when conveying a specific material at a specific speed and with an appropriate distance between axes is specified in the order placed with RUD Ketten and in the confirmation of order by RUD Ketten. Any other use or use going beyond the intended use – for example higher conveying capacities or speeds, conveying other materials, or use under unapproved operating conditions – shall be regarded as use for other than the intended purpose.
- Usage for the intended purpose also includes complying with this fitting and operating guide, and complying with the inspection and maintenance specifications.

The manufacturer shall not be liable for damage resulting from usage for other than the intended purpose. The user shall bear the risk alone.

2 Safety Instructions

2.1 Explanation of Symbols and Notices

 **Warning!**	**Danger to life and limb, or substantial material damage can occur if the appropriate safety instructions are not followed.**
Attention!	**Undesirable consequences or working conditions can arise if the appropriate safety instructions are not followed.**

2.2 General

 **Warning!**	**Follow the safety instructions. Otherwise there is danger to the life and limb of the user and third parties, and of damage to the machine and other tangible assets.**

- Mounting, dismounting, repairs, overhauls, and wear measurement may only be performed by competent persons who are familiar with the operating manuals and trained people.

- Inform the operating personnel and appoint supervisors before starting maintenance work.
- Secure machines and equipment against being started unintentionally.
- Switch off the main control systems, remove keys, and attach warning notices.

- Before mounting/dismounting work, secure the chain strand against movement. When mounting/dismounting chain equipment, a one-sided load can set the chain in motion and cause injuries which may prove to be fatal.

- Protect the working area against falling materials and components.

- When mounting and replacing individual parts or larger modules, attach and secure them carefully to the lifting equipment so that they cannot become a source of danger. Only use suitable and technically faultless lifting equipment and load hitching tackle.
- Do not stand or walk under suspended loads.

- As a rule, all components must be mounted and dismounted in an electrically dead state, unless otherwise stated. Risk of crushing!

- All parts of the plant must have cooled down to the extent that they can be touched without causing burns.

- Appoint only operating personnel with valid certificates of entitlement to hitch loads and instruct crane drivers. The spotter must remain in view of the operator or be in voice contact with him.

- The platforms provided and climbing aids complying with safety regulations must be used for assembly work above head height. Do not use machine parts as climbing aids. Wear protection against falling when performing maintenance work at great heights.

- Operating and process materials must be disposed of safely and in a way that does not harm the environment.

- As a matter of principle, no welding work is permitted to be done on round steel chains, chain couplings or case-hardened module components. The chain must not be used as a ground connection to the steel structure for electric welding.

- Welding, burning and grinding work may only be performed on the plant when this has been expressly authorized. Before starting welding, burning or grinding work, clean the plant and its surroundings of dust and combustible materials, and ensure adequate ventilation. There could, for example, be a risk of fire or explosion.

- Ensure that screw connections are tightened with the defined torque. Always check these connections with a torque wrench.

- Persons are not allowed to ride on the conveyor.

- For safety reasons, it is forbidden to make any modifications or alterations to the components without the manufacturer's authorization.

- All methods of working which are of questionable safety are forbidden.

- In addition to the operating instructions, comply with and implement the generally applicable, legal and other binding accident prevention and environmental protection regulations. For example, the handling of hazardous substances and the provision and wearing of personal protective clothing and equipment.

2.3 Care and Maintenance

- Wherever necessary, cordon off the maintenance area, allowing a wide safety margin.

- Before starting maintenance work, cordon off the working area of the machine/equipment to prevent the access of unauthorized persons. Attach or put up suitable notices advising of the maintenance work.

- Any material adhering to or remaining in the buckets can come loose and fall out. Switch off the material feed, and empty the bucket elevator before opening the inspection flaps. Wear a safety helmet while working.

3 Description

The RUD System High Wear-Resistance consists of the following parts:

- Round steel chain **10**
- Sprocket wheel **20** or pocket chain wheel **30**
- Guide wheel 50
- Chain coupling **60**
- Attachment **70**

During the negotiation and clarification of the order, RUD and the customer generally select the components best suited to the conveying task, and these are put together in accordance with our modular system. The components are delivered packed separately.

Attention!

Please comply with the following general operating instructions for this system:

- **Specified RUD sprocket wheels (F20533 / WV1), (F20534 / WV1), or pocket chain wheels (F20535 / WV1), (F20536 / WV1)**
- **Specified RUD chain couplings (F20537 / WV1), (F20538 / WV1), (F20539 / WV1)**
- **RUD conveyor chains (F20521 / WV1)**
- **Specified attachment (F20522 / WV1 up to and including F20532 / WV1, as well as F20564 / WV1)**
- **If specified, RUD guide wheels (F20541 / WV1)**

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4 Fitting

4.1 Mount the wheels on the appropriate shafts

1. Shrink on a pair of wheels, both marked with the same colour, on a shaft.
2. Mount the drive wheels and guide wheels so that the centres of the wheels are exactly aligned with one another.
3. Move the take-up shaft at the start of the take-up unit. That makes subsequent assembly easier.

4.2 Align the shafts

Align the shafts exactly parallel and horizontally. This and correct positioning of the wheel centres are absolutely essential.

4.3 Join the ends of the individual chain strands with chain couplings

4.4 Pull the connected chain strands into the system

For single and multistranded conveyors:

Attention!

1. **The welded joints of the vertically arranged links must face the centre of the wheel when they pass over the drive wheels (fig. 1).**
2. **Ensure that the chain couplings are oriented correctly to the sprocket wheels – with the coupling screw parallel to the axis of the sprocket wheel – (this also applies to pocket wheels and grooved wheels) (figs. 1 and 2). The nuts must face the centre of the conveyor system. This prevents damage occurring to the chain coupling or system.**

Bolted connections in bolt strength class 8.8, locking nuts V according to DIN 980-8. The permissible bolt tightening torques are to be found in the table in the last section.

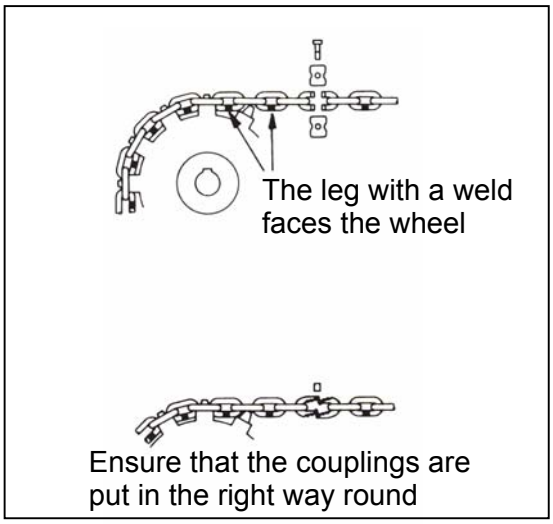

Fig. 1

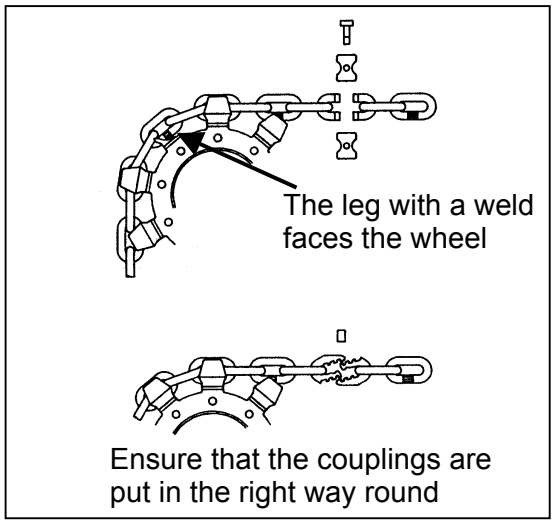

Fig. 2

4.5 Close the chain loops

1. Slacken the chain at the guide wheel shaft in the take-up unit.
2. Carefully detach superfluous chain links (see Disassembly).
3. Join the ends of the chain loops with chain couplings.

4.6 Attach the flange-mounted parts.

4.7 Tension the chain

Define a usable tensioning range taking into account the length of the loop and the aggressive stress acting on the chain. The takeup tension must not be greater than that required for the chains and attachments to run faultlessly under normal operating conditions. The takeup tension must be the same in all the chain loops of multistranded conveyors.

Attention!

- **Maintain a continuous takeup tension by means of springs or weights in an adjustable tensioning device. The magnitude of the chain takeup tension must be matched to the requirements of the particular conveyor.**
- **Maintain the chains under the correct takeup tension throughout their service lives. A slack chain increases link wear.**

4.8 General guidelines

Attention! **Comply with the following general guidelines.**

1. Attempt to achieve maximum loading of the attachments, That means adjusting the chain speed to the quantity of material conveyed.

2. The material must be fed in so that it is distributed evenly across the width of the conveyor, and all chain loops are equally loaded by the material and tractive force. This prevents one-sided wear on.
   If an angled feed is unavoidable
   ➔ Attach a diverter plate so that the material flows centrally onto the width of the conveyor. Unequal loading of the loops causes unequal wear and pitch increases on the individual chain loops. This causes the buckets to lie at an angle which, in turn, can lead to faults in the guide station.

3. Protect round steel chains against overloading or blocking by foreign bodies by fitting suitable safety clutches, shearing pins etc. in the drive.

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4. Clean off material adhering to the round steel chains upstream of sprocket and wheel inlets by means of scrapers, compressed air or water jets.
   If a lot of material is adhering to the chain running into the drive wheel or guide stations, then suitably robust chain scrapers and chain guides may have to be fitted at these points.

5. If, for example, as a result of the accumulation of material the chain is in danger of lifting off a sprocket or wheel, then a chain depressor or chain cross must be fitted before, after or over the whole range of the chain wrap.

6. When conveying material that tends to consolidate or harden, keep the grooved wheel rim profile clear with a scraper.

7. Support the chain and attachments when an excessively long length of freely hanging chain requires an excessive chain take-up tension.

8. The discharge points of trough chain conveyors must be located at a distance from the drive or guide wheels that is adequate for the size and quantity of material conveyed.

9. Comply exactly with the assembly dimensions and tolerances stated in the mounting drawings when:
   - Mounting sprocket wheels/pocket chain wheels and guide wheels
   - Manufacturing attachments
   - Attaching chain guide rails

10. In order to prevent the chain loops of multistranded conveyors stressing each other, no more than two guide wheels may be mounted on a takeup shaft, and at least one of them must be able to turn freely. In the case of guide wheel shafts only one wheel may be bonded.

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5 Disassembly

5.1 Shortening the chain

Chain links must be cut out carefully and without damaging the adjacent links. For example by tempering caused by thermal cutting.

Attention!

- **Cover adjacent chain links**
  This prevents fire damage to chain links.
- **Do not heat adjacent chain links.**
- **Always cut the 2nd, 4th, 6th etc. link from the chain strand.**
- **RUD chain couplings run as vertically arranged links over RUD sprocket wheels.**
- **Cut the same number of links out of both chain loops.**

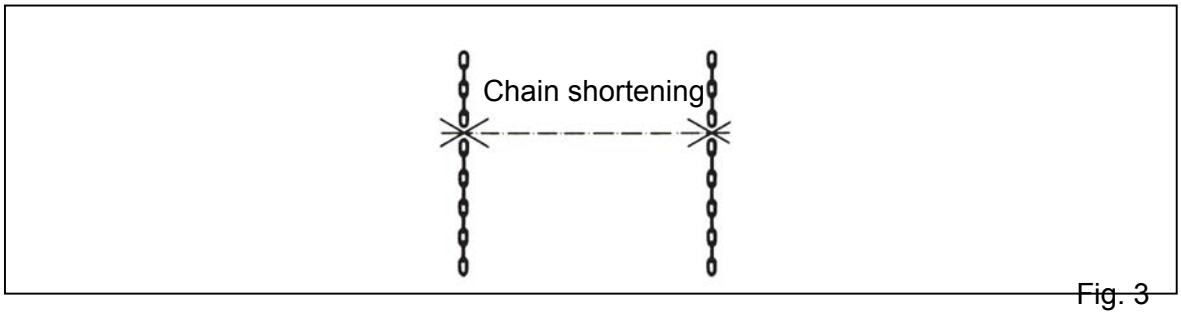

Fig. 3

Shorten the chain as follows:

1. The conveyor system must be completely empty of the material conveyed. Check for missing and damaged scraper bars and attachments.
2. Stop the conveyor in a position advantageous for shortening the chains.
3. Switch the conveyor off.
4. Slacken the chain at the guide wheel shaft in the take-up unit.
5. The chains must be slack enough to open and remove the same number of links from both strands.
6. Attach and tighten the chain couplings.
7. Lower the guide wheel shaft and set it as described in section 4.7.
8. Reconnect the electrical supply to the motor, and make a trial run of the conveyor.

5.2 Dismantling the system

1. The conveyor system must be completely empty of material conveyed.
2. Stop the conveyor in a position where the chains can be opened easily.
3. Switch the conveyor off.
4. Slacken the chains at the guide wheel shaft in the take-up unit.
5. The chains must be slack enough to open.
6. Remove the scrapers bars and attachment from the conveyor system.
7. Remove the chain couplings.
8. Remove the individual chain strands.

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6 Care and Maintenance

We recommend that you keep records of your maintenance work on the conveyor system, including their running times and the repairs that have been made. Only well-maintained conveyor systems achieve long running times.

6.1 Lubrication

Under normal circumstances, RUD conveyor chains do not require any lubrication.
The chains may only be lubricated with standard engine oil. Grease must not be used.
Dirty chains should be cleaned before being lubricated.

6.2 Takeup Tension

Check the tension in the chains regularly, especially during the running-in phase of new chains and/or where the loop lengths are long. The takeup tension must not be greater than that required for the chains and attachments to run faultlessly under normal operating conditions. The takeup tension must be the same in all the chain loops of multistranded conveyors.

Attention! **Excessive tension shortens the service life of the system.**

6.3 Monitoring

Examine the chains, couplings, sprockets, wheels and flange-mounted parts every six months, or at least annually, for damage, corrosion and points of unusual wear. Pay particular attention to the condition of the bolted joints and safety components. Rectify all defects found without delay.

7 Wear and Replacement State of Wear

Under normal conditions, wheel teeth and round steel chains reach a replacement state of wear at the same time.

In the case of sprocket wheels (internally toothed wheels) this is reached when the measured pitch of the chain resulting from wear has increased by 1.5% – 2.5% (or more), and the chain links also engage jerkily with the drive wheel under normal chain take-up tension, and disengage with difficulty or suddenly, that is they are taken past the normal disengagement point. In such cases, it may be possible to use teeth with higher link rests in order to ensure that the chain runs smoothly.

In the case of pocket wheels (externally toothed drive wheels) a pitch increase resulting from wear of up to 4% may acceptable under certain circumstances.

With long distances between axles and when conveying very abrasive or corroding material at high conveyor speeds, and/or under the effects of heat and similar conditions, the chain may engage and disengage jerkily with the drive wheel although the measured pitch increase resulting from wear is still less than 1.5 percent.

Attention!

- **In such a case, change the wheel teeth on all the drive wheels at the same time.**
- **As a matter of principle, new round steel chains may only be used with new wheel teeth.**
- **Round steel chains on which the average thickness of the link has fallen by more than 10% of the nominal thickness must be taken out of service. (Averaged thickness of the link = average measurement of two measurements made at a right angle to one another at the link cross-section showing the most wear).**
- **Components must always be replaced when damage occurs which directly or indirectly endangers the safety or operation of the system.**

8 Maximum Permissible Bolt Tightening Torques

The factors influencing the tightening torques stated in VDI 2230 must be taken into account when mounting bolted parts. Retighten all nuts after two weeks' operation, and ensure that they are tightly seated.

8.1 Table 1: Maximum Tightening Torques

	For bolt strength class 8.8 with overall coefficient of friction μ_{over} = 0.14		For 2win and SWA threads with overall coeff. of friction μ_{over} = 0.14		For DIN 555 hex nuts quality class 5	For DIN 934 hex nuts quality class 8	For DIN 980V hex nuts
	Tightening torque		Tightening torque		Tightening torque	Tightening torque	Tightening torque
Thread size	(Nm)	(ft-pd)	(Nm)	(ft-pd)	(Nm)	(Nm)	(Nm)
M 6	10	7					
M 8	25	18					
M 10	49	35			30	51	55
M 12	85	62			52	89	95
M 14	135	98			83	140	149
M 16	210	152	149	108	127	213	225
M 20	425	307	293	212	245	420	439
M 22	580	420					
M 24	730	528	506	366	420	725	752
M 27	1100	796					
M 30	1450	1049	1000	723	847	1451	1487
M 33	1900	1347					
M 36	2450	1772	1700	1230	1480	2531	2575

8.2 Table 2: Recommended Values for the Tightening Factor α_A:

Tightening factor α_A	Variation	Tightening method	Setting method	Comments	
1.7 to 2.5	26% to 43%	Torque-controlled tightening with mechanical screwdriver	The screwdriver is set with a tightening torque comprising a nominal tightening torque (for estimated coefficient of friction) plus an allowance.	Low values for: →Large number of checks (tightening torque) →Screwdriver with breaking coupling	Low values for: →Small angles of rotation, i.e. relatively rigid connections. →Relatively soft backing. →Backings which do not tend to scuff. Higher values for: →Large angles of rotation, i.e. relatively flexible connections. →Very hard backing coupled with rough surface. →Form errors
2,5 to 4	43% to 60%	Pulse-controlled tightening with impact wrench.	Screwdriver set with tightening torque, as above.	Low values for: →Large number of setting attempts (tightening torque). →On horizontal axis of screwdriver curve. →Zero-backlash pulse transmission.	

8.3 Example of Procedure

Attention!

This procedure cannot replace calculations as defined in VDI 2230 (Association of German Engineers), and it does not correspond to the state-of-the-art. Nevertheless, it can at least prevent bolts breaking during assembly work with bolts for which no calculation has been made.

Step 1: Coefficient of friction $\mu_{over.}$ corresponds to the friction class.
The lowest coefficient of friction practically achievable with the state of the surfaces and lubrication of the thread and contact area must be selected. For simplification, $\mu_{over.}$ = 0.14 is assumed for bolts that have not been given any after-treatment.

Step 2: Maximum assembly tightening torque M_A.
The maximum tightening torque is defined for each specific product below 90 percent utilization of the 0.2% permanent elongation limit ($R_{p0.2}$) or the apparent limit of elasticity (R_{el}). These values can be found in table 1.

Step 3: Tightening factor α_A:
This takes into account the variation of the tightening force achievable during assembly between F_M min and F_M max. The bolt is dimensioned for the maximum tightening torque so that it will not be overstressed during assembly. The imprecision of the tightening process is caused by:

- Errors calculating the coefficient of friction
- Variation of the frictional behaviour and repeating accuracy
- Differing tightening methods
- Device, operating and reading errors

The tightening factor α_A has to be selected in accordance with how the above-mentioned influences can be controlled. These values can be found in table 2.

Step 4: Assembly tightening torque M_A of the tool
This is the torque set on the tool, for example a mechanical screwdriver.

$$M_{AWerkzeug} = M_A\,\text{max.} - \left(\frac{M_A\,\text{max.} - M_A\,\text{min.}}{2}\right)$$

$$M_A\,\text{min.} = \frac{M_A\,\text{max.}}{\alpha_A}$$

Example: Maximum tightening torque M_A max. = 425Nm
Tightening factor α_A = 1.7

$$\rightarrow M_{AWerkzeug} = \frac{1}{2}\left(M_A\,\text{max.} + \frac{M_A\,\text{max.}}{\alpha_A}\right) = \frac{1}{2}\left(425Nm + \frac{425Nm}{1{,}7}\right)$$

$$\rightarrow M_{AWerkzeug} = 337{,}5Nm$$

Step 5: Check
Thoroughly check the bolted connections with a torque wrench.

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