PAUL WURTH

ERECTION MANUAL
Erection of BELL LESS TOP

MIDI BELL LESS TOP ®
JINDAL STEEL WORKS TORANAGALLU BF 2






5019064 – JSW – TORANAGALLU BF2

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☒ Original instructions

☐ Translation of the original instructions

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Revisions

REVISION	DATE	AUTHOR	APPROVED	COMMENTS AND REVISED PAGES

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General Information

WARNING

Make sure that all safety precautions are observed.

Failure to follow the safety instructions in this manual can result in serious injuries or equipment damage.

All operation and maintenance personnel must be trained to ensure that the personnel has familiarized themselves with the equipment and associated hazards.

Unauthorized personnel must not be permitted to enter the Bell-Less Top or the areas adjacent to this equipment.

NOTE

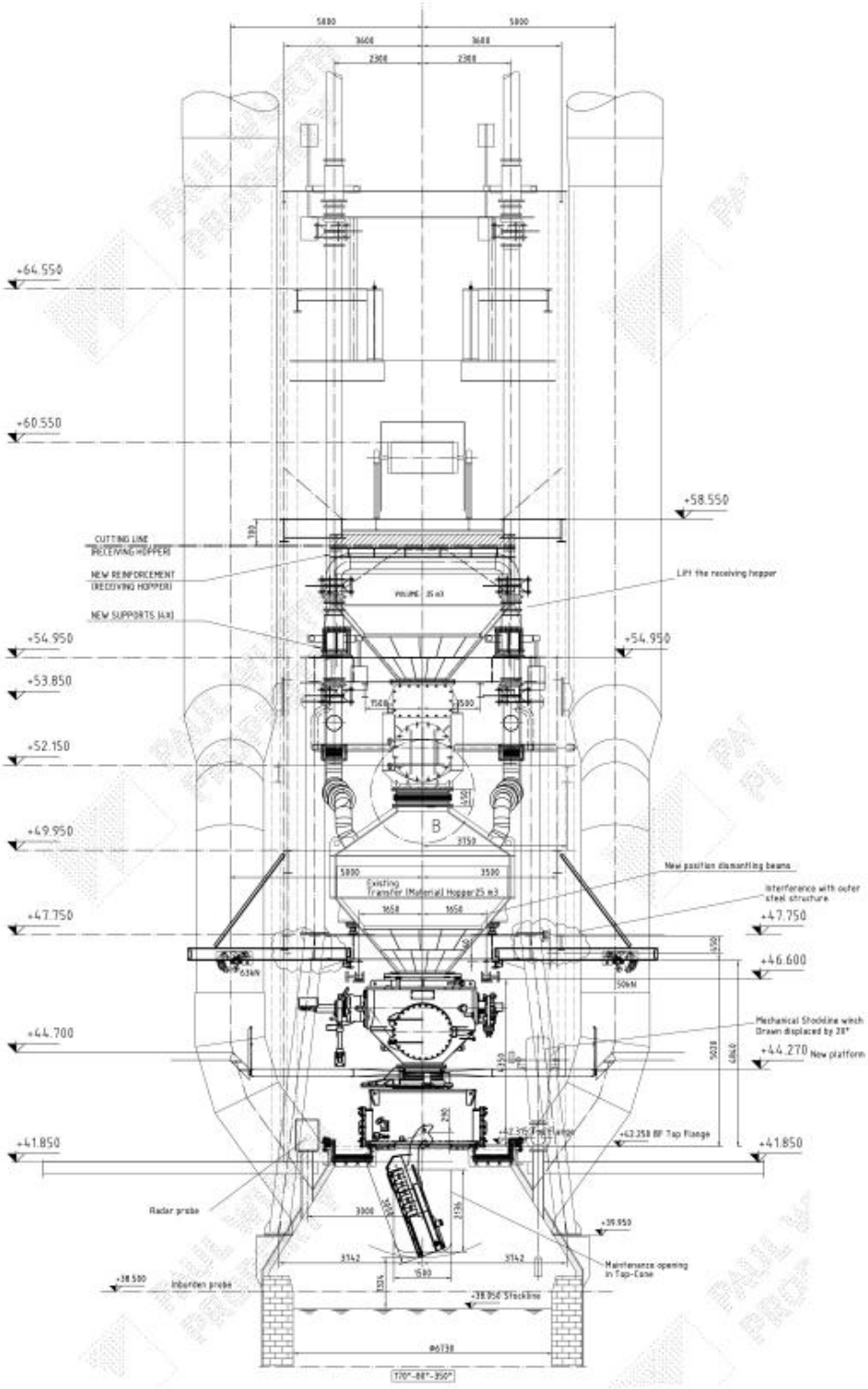
All BLT equipment will be erected by customer's contractors. The erection companies will be wholly responsible and will provide all materials, tools, tackles and apparatus for off-loading and erection of the specified equipment.

The here follow erection procedure is one possible proposal. The final procedure will be discussed and executed by customer's erection company.

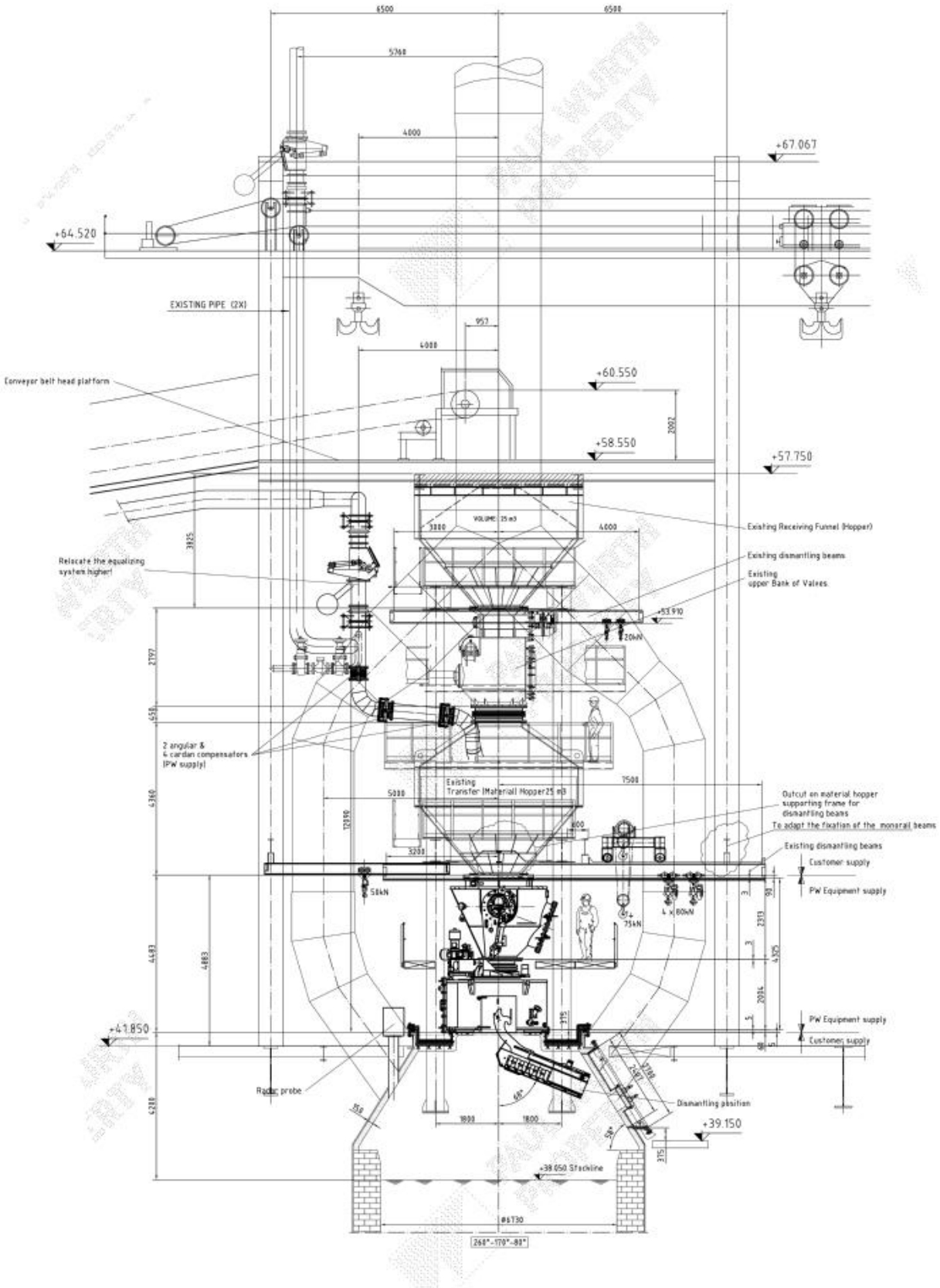
The erection company is full responsible of their erection sequence.

1 BELL LESS TOP DESCRIPTION

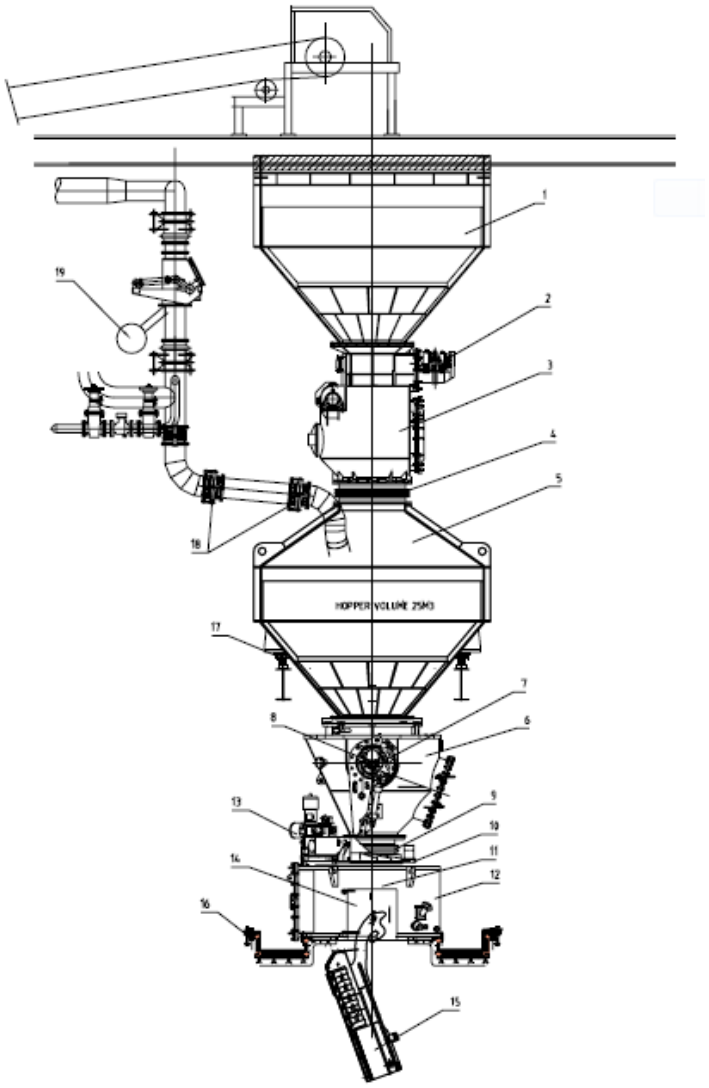
1.1 VIEW 170°-80°-350°



1.2 VIEW 260°-170°-80°



1.3 COMPONENTS



1. Receiving hopper
2. Upper material gate (UMG) Totem
3. Upper seal valve (USV) Totem
4. Bellow Arrangement ND1400
5. Material hopper 25m^3
6. Valve actuating unit (VAU)
7. Lower seal valve (LSV) ND900
8. Lower material gate (LMG) ND750
9. Bellow arrangement (BA) ND 900
10. Goggle valve (GV) ND 900
11. Feeder spout (FS)
12. Chute transmission gear (CTG)
13. Planetary gear box (PG)
14. Chute angle adjusting gear (2 units) (GAAS)
15. Distribution chute (DC) L = 3.5 m
16. Intermediate flange
17. Load beams (4 units)
18. Expansion bellows for equalizing system
19. Equalizing and relief valve

The Bell Less Top is designed to receive and distribute raw material in the blast furnace.

It is composed of:

- receiving hopper
- upper material gate
- upper seal valve
- material hopper with 4 load beams
- valve actuation unit with lower seal valve and lower material gate
- bellow arrangement
- goggle valve
- chute transmission gear box with planetary gear box
- distribution chute

All BLT equipments can be accessed for erection or maintenance purposes (mechanical, electrical and instrumentations).

The Bell Less Top is closely linked with the inner tower, the equalizing and the dismantling structures.

Due to all these conditions, the erection of this structure has to be made with the utmost care and precision.

2 WELDING AND CONTROLS

2.1.1 General

The welding works must be supervised by a qualified and experienced welding supervisor (e.g. welding engineer/technician).

All welders must be fully qualified for the welds to be performed in accordance with the applicable standard (e.g. EN 287-1). Additionally they all have to carry out a satisfactory performance test before start any welding work.

For all welds, welding procedure specifications (WPS) must be prepared in accordance with the applicable standard (e.g. EN ISO 15609-1).They shall be available at the welders' working place.

All welds have to be covered by a welding procedure qualification record (WPQR) as per the applicable standard (e.g. EN ISO 15614-1).

Welding consumables shall comply with the applicable standards (e.g. EN, ISO, AWS). The type of the consumables must be adequate for the parent metals used and they must be approved by an independent authority (TŰV, BV, LR, GL or equivalent). Chemical analysis and/or mechanical properties must be confirmed by a 2.2 test report according to EN 10204.

2.1.2 Execution

Welding consumables must be kept in a dry environment. Before use, the electrodes shall be re-dried according to the instructions of the manufacturer.

The welding consumables shall be properly protected against the environmental influences during work interruptions.

At the work place, electrodes from a heated carrier bag (quiver) shall be used for manual metal arc welding (111) - also for tack-welding.

The temperature in the carrier shall be sufficient to avoid that the electrodes take up moisture again.

The welding areas must be suitably protected against draught and rain. The welding seam preparation shall be free of contamination, such as rust, paint, grease, oil, slag etc.

For butt-joints, run-in and run-off plates have to be used where possible.

Preheating and inter-pass temperature for butt welds, fillet welds and tack welds have to be in accordance with the welding procedure qualification tests and must suitable for the parent metal.

Ignition of the electrodes shall only take place in the welding grooves. Arc strikes occurring outside of the welding seam shall be carefully removed by grinding. Notches shall be removed in a workmanlike manner.

Tack welds shall be made with a min. length of 50mm; broken tack welds shall be ground, over welding is not permitted.

An appropriate spacing between the tack welds shall be chosen, they shall not be at end or corner areas of the weld. Tack welds shall be made in accordance with the same requirements like permanent weld seams (preheating, etc.)

Temporary attachments shall only be executed if there are no other means to join/lift the parts. After using, the temporary attachment shall be removed in an appropriate manner, tearing off from base material has to be avoided.

The remaining welding seam area shall be ground in a workmanlike manner and visually and magnetic particle (MT) or penetrate (PT) tested for cracks.

For preheating and weather conditions, the same requirements are applicable as for the permanent welds.

Deformation during welding shall be minimized through appropriate welding procedures, sequences and methods. Material shrinkage shall be considered.

2.1.3 Testing

The welds shall be tested / evaluated in accordance with the testing instruction 'Non-Destructive Testing (NDT) of welding – Mechanics Medium Requirements' (see below).

Unaccepted welding seams must be repaired.

The repaired area shall be 100% tested according to the original test method.

The personnel for non-destructive testing must be qualified for the applied testing method in accordance with EN 473, level 2, ASNT-TC1A, level 2 or equivalent qualification.

Defective areas shall be ground, respectively gouged (e.g. arc air).

If carbon electrodes with copper coating are used, thorough grinding shall be done after gouging.

With regard to the pre-heating and welding parameters, the repair weld shall be executed like the original weld upon consultation with the welding supervisor.

NON-DESTRUCTIVE TESTING (NDT) OF WELDING - MECHANICS MEDIUM REQUIREMENTS						
Non-destructive test	Standard		Acceptance standards		Scope of testing	
	EN	AWS	EN	AWS		
Visual examination (VT)	EN 970	AWS D 1.1	ISO 5817 Quality level C	AWS D 1.1 Table 6.1 Statical loaded non-tubular connections (N.B.: Undercut limited to max 0.5mm)	100 %	
Magnetic particle inspection (MT)	EN 1290	AWS D 1.1	EN 1291 Acceptance level 2x	AWS D 1.1 Section 6.10	B A; C; D; F; G	100 % × 20 % ×
Penetrant testing (PT)	EN 571-1	AWS D 1.1	EN 1289 Acceptance level 2x	AWS D 1.1 Section 6.10	B A; C; D; F; G	100 % × 20 % ×
Radiographic testing (RT)	EN 1435	AWS D 1.1	EN 12517 Acceptance level 2	AWS D 1.1 Section 6.12.1	F G	20 % 100 %
Ultrasonic testing (UT)	EN 1714	AWS D 1.1	EN 1712 Acceptance level 3	AWS D 1.1 Section 6.13.1	C D	20 % 100 %

× Magnetic particle inspection can be replaced by penetrant testing and inversely

A : Standard fillet welds (e.g. web to flange)
B : Lifting eyes
C : Full penetration welds and butt welds (K welds) (thickness t>=10mm)
D : Full penetration welds not mentioned or indicated in the drawing (thickness t>=10mm)
F : Full penetration welds (thickness t<10mm)
G : Full penetration welds not mentioned or indicated in the drawing (thickness t<10mm)

1) Welds marked with (#) must be included in the test scope
2) In case of defect detection at partial extent of testing (e.g. 20%), the extent has to be increased in gradual manner
3) In case of doubt, radiographic examination must be supplemented by ultra-sonic examination and inversely
4) At the beginning of fabrication, the extent of testing must be increased in order to verify, if the welding parameters/process a.s.o. are correct
5) In case of partial surface crack examinations (e.g. 5%) the zones to be checked must also be chosen, where visual examinations give some doubt, furthermore weld crossings and end of welds must be checked
6) All NDT must only be performed at least 24 hours after welding completion

TECHNICAL REQUIREMENTS

Please consult the technical specification and quality inspection plan (QIP) of the project.
In case of different requirements the stricter ones have to be applied.

3 SAFETY ON SITE

Safety during this furnace revamping is of utmost importance due to the nature of works involved.

In general all safety measures have to comply with the European regulations and laws.

The main work areas to be monitored for safety will be as follows:

- Working at height (overhead work).
- Safety against toxic gases / fumes in and around the blast furnace.
- Safety against materials falling due to simultaneous working at various levels.
- Working at night.
- Stringent checks for live/power lines etc.

Before the beginning of the work, the erection company has to establish a detailed written job method statement for all planned work. The job method statement must demonstrate that all significant risks have been assessed and that all precautions have been highlighted to reduce the risk to an acceptable level. Suitable measures have to be taken to ensure that safe working methods are employed during activities.

Adequate safety engineers shall be deployed to ensure the strict observance of the safety regulations.

The target for safety on this erection project to be kept in mind is: ZERO ACCIDENTS.

All the personnel supposed to work on site or whose presence on site will be necessary, are required to attend a JSW health and safety training. The erection company will confirm that its personnel are well skilled people and fully instructed in safety matters. The erection company will be held fully responsible for any accident caused by any of his employees.

The followings are the minimum safety regulations. Some tasks do not need all these items being applied, but the operators and workers have to take care that all the safety rules are applied.

3.1 LIST OF BASIC SAFETY EQUIPMENTS REQUIRED

This list is not limited to following items; the erection company is responsible to have all necessary safety equipments on site as per the European regulation.

- Safety helmet (e.g. fibre glass);
- Safety shoes;
- Gloves;
- Dust mask;
- Dust goggles;
- Face shield for grinder/chipper;
- Cutting goggles for gas cutter;
- Welding shields for welder;
- Ear plugs (i.e. for pneumatic tool operator) if the sound level is too high according to local regulation / law / recommendations;
- ELCB for all electrical tools and machinery;
- Gas masks and breathing equipment;
- Safety belts and harnesses;

3.2 SAFETY CONDITIONS REQUIRED

- Life line to be provided for safe passage and tying the safety belt.
- Safe access to be provided to the working places.
- The working places have to be adequately lighted.
- Persons to be trained for giving proper signals during any lowering/hoisting operations.
- All lifting tools, tackles, wire ropes and pulleys have to be approved by an official institution and are to be checked periodically.
- Before lowering/hoisting any material, weights are to be ascertained for selection of proper lifting tackles.
- Access ladders are to be secured properly.
- Openings made at any site area should be barricaded and covered if not used.

- All persons working at heights over 2 m above any platform or ground level must wear a safety harness and it should be anchored properly to a permanent structure.
- Life lines are to be provided wherever possible.
- Fire extinguishers must be provided and kept ready at the places where cutting and welding operations are in progress.
- Gas hoses and pressure regulators should be checked regularly for leakages.
- Signaling must be given by an authorized person for all lifting and lowering operations being done by the outrigger crane.
- All scaffolds should be designed according to the local FNsteel safety standards and must always be provided with handrails.
- All hydraulic circuits are to be checked periodically for any leakages.
- During arc welding a suitable non-combustible screen has to be used to protect anyone who could be affected, e.g. passers-by, crane operators.
- The area below and near the launching tracks are to be barricaded while shifting the shell for erection.
- Debris should be removed regularly to maintain a clean site.
- First aid offices, hospitalization and ambulance station have to be clearly directed by panels and be easily accessible.

4 GENERAL REQUIREMENTS

The erection company has to follow the prepared time schedule as well as the erection method. Any modification to the actual contractual time schedule and the erection concept should be discussed with the JSW responsible persons to get their approval.

The supplies will be delivered in accordance with PW overall time schedule and the related milestones.

The erection company will provide all necessary equipments to allow the correct and safe erection of the plant.

This includes, but is not necessarily limited to:

- all necessary cranes, engines, special tools, power;
- all necessary manpower with the required qualifications;
- all necessary lighting for the different working places;
- all temporary working platforms and scaffolds needed, designed to meet the
- JSW safety standards;
- adequate welding equipment and necessary electrodes, welding wires, shielding gas, etc;
- containers and/or rooms to store all fixing materials.

The erection company shall submit a QA-Manual according to ISO 9001 or equivalent.

JSW should indicate the storage areas and pre-assemble areas to the erection company's disposition. It is up to the erection company to organize and to arrange these areas at its convenience to perform its work in the best way.

The erection company has to foresee the unloading and storing of all items and protect these equipments.

The erection company starts to handle delivered items for erection, they fall under its responsibility for any damage caused during handling and/or incorrect installation.

All deteriorated/lost pieces will be charged to the erection company by JSW.

All damages, caused by the erection company to new supplies, materials or existing installations, will be repaired at its expenses without any delay to the overall schedule.

The erection company is responsible for all temporary dismantling and re-erection and modification works of existing items, necessary to enable the assembling and connecting of new components.

During the construction and erection works, the erection company has to provide all necessary controls in order to guarantee an accurate quality. This means that the erection company has to supervise using professional surveyors in order to ensure that the elevations, axis, dimensions, verticality are in accordance with the allowable tolerances and that all components are assembled and erected in a correct and professional manner.

At least one surveyor has to be full time on site to verify all necessary elevations and site surveys and allow a correct assembling and installation of the equipments.

Specific test reports have to be established and signed by the erection company

During dismantling and erection, the erection company has to guarantee the stability, resistance and safety of steel structures installed temporarily or definitively.

It is of utmost importance, and makes part of the site safety requirements, to remove regularly all scraps and debris from the work sites.

5 BELL LESS TOP ERECTION DESCRIPTION

5.1 INTRODUCTION

The erection company is fully responsible of their erection sequence. This task coordination must take into account the following factors:

- Security of the people and material (accessibility, safety lines…)
- Availability of the required area and goods
- Soil conditions
- Capacity of the cranes
- Superposition of tasks/people, coordination with the other companies or teams working in the same zone
- Weather conditions
- Contractual obligations

A detailed erection schedule has to be issued, showing all the sequences with the links to the other implicated tasks

The level of pre-erection should be as high as possible, this to reduce as much as possible the work do be executed on site.

5.1.1 Lifting:

For all lifting, a drawing has to be issued, showing the position of the crane (s) and its (their) positions of stabilizer jacks/crawler…, the maximum soil bearing, the dimension and weight of the part to be lifted, the rope (type, length, capacity…), abacus of the crane (s)…

Due to the nature of the soil, the erection company must indicate in the beginning of the erection a working area of the cranes with the required soil bearing. No lifting work will be allowed before a written acceptance of this working plan has been issued by JSW.

5.1.2 Stability and integrity during erection:

It is of utmost importance for the erection company to establish its erection sequence in such a way to ensure the stability and the integrity of the Bell Less Top, personnel, surrounding plant components, etc. during the complete duration of the erection.

If temporary solutions (i.e. erection bracings, spacers, lifting devices…) have to be used, these items have to be suitably engineered. The supply, installation, dismantling… are in the scope of the erection company.

For each erection phase all necessary statically calculations have to be made (integrating lifting and erection temporary devices).

5.2 STATEMENT ABOUT TOOLS FOR ERECTION

CHUTE TRANSMISSION GEAR:

- 1 Instrument for chute angle adjustment (angle gauge, ex.: miracle point indicator)
- 1 Optical leveling instrument, measuring ≤ 0,05 mm with valid calibration certificate.
- 4 Manual hoists 8 000 kg for suspending the casing during erection.
- 1 Pneumatic air tool complete with sockets (width across flats 41) for tightening bolts (M27x190) between the intermediate flange and the transmission gear.
- 1 Torque wrench - 450 Nm socket width across flats 41 mm.
- 4 guiding bars ø 25, 500mm long
- 1 Set of standard tools

DISTRIBUTION CHUTE:

- 1 Dismantling device for chute.
- 1 Electric operated chain hoist, hoisting capacity 5000 kg,
- 1 Pneumatic, electric or manual operated chain hoist, hoisting capacity 2000 kg,
- 2 chute dismantling rig with remote controlled chain hoists, hoisting capacity 2000 kg each,
- 1 Set of standard tools

VALVE ACTUATION UNIT:

- 1 Set of standard tools
- 4 Manual hoists 8 000 kg for suspending the casing during erection.
- 1 Pneumatic air tool complete with sockets (width across flats 46 and 36) for tightening bolts (M36x90 and M24x120) between the valve casing and the material hopper and between the bellow arrangement and the valve casing.
- 1 Torque wrench - 700 Nm socket width across flats 55 mm
  - 294 Nm socket width across flats 36 mm

BELLOW ARRANGEMENT ND1400:

- 1 Set of standard tools
- 1 Pneumatic air tool complete with sockets (width across flats 55) for tightening bolts (M36x130) between bellow arrangement and material hopper and between bellow arrangement and receiving hopper.
- 1 Torque wrench - 700 Nm socket width across flats 55 mm

WEIGH BEAMS DWB 25:

- 1 set of standard tools

INTERMEDIATE FLANGE:

- 1 Optical leveling instrument, measuring ≤ 0,05 mm with valid calibration certificate
- 1 Pneumatic air tool complete with sockets (width across flats 75) for tightening bolts (M48x330) between the throat ring and the intermediate flange
- 1 Torque wrench - 1400 Nm socket width across flats 75 mm.
- 1 wrench 60mm for leveling screws M39x200
- 1 set of standard tools
- 1 arc welding machine

HYDRAULICS:

- 1 Set of wrenches (8 – 48 mm) for purging hydraulic cylinders, adjusting end-position cushioning of cylinders and fixing the flexible connections.
- 1 set of wrenches for socket head cap screws 2-20 mm
- 1 Pressure gauge with connection and pressure hose for filling and checking the nitrogen pressure of the N2 bottles of the hydraulic accumulator station
- 1 Compact type measuring kit (minimess box) for measuring the hydraulic pressure, pressure loss, etc.
- 1 Stop watch for setting opening and closing times of the various valves, sealing valves and material gates

Important Note

The outrigger crane or a heavy load moveable crane needs to be available during the whole BLT erection work.

5.3 WEIGHTS OF MAIN EQUIPMENT

1.	**Material Hopper 25m^3 without upper seal valve (Totem)**	
	• With wear lining	**22 250 Kg**
2.	**Valve Actuation Unit**	
	Weight completely assembled with material gate and lower seal valve	**21.500 kg**
3.	**Water Cooled Transmission gear**	**22.500 kg**
	• with Bellow Arrangement and Goggle Valve;	
	• with planetary gearbox	
	• with tilting gearbox	
	• with feeder spout	
4.	**Planetary gearbox (already installed on chute transmission gear)**	**1800 kg**
	• Without electric motors (300kg each)	
5.	**Bellow Arrangement ND 1400**	**764 kg**
	•With wear protection	
6.	**Intermediate Flange**	**19000 kg**
	•Without gunnable Refractory	
7.	**Distribution Chute L = 3,5 m**	**2400 kg**
	•Distribution chute	

Note

All the above mentioned weights are calculated weights. For actual weights, please refer to the delivery and transport documents.

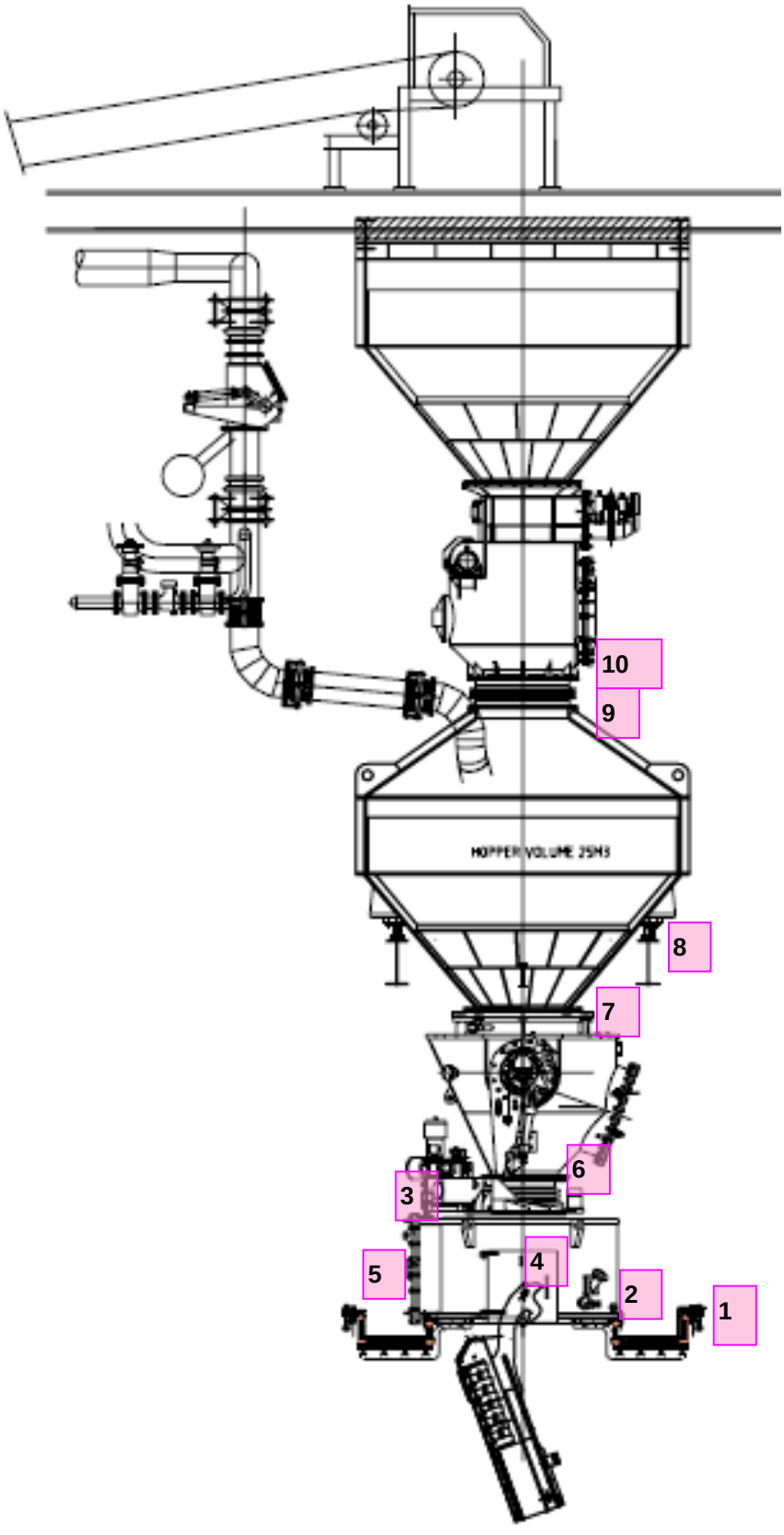
5.4 HARDWARE FOR MAIN CONNECTIONS

Pos.	Connection		Material	Seize [mm]	Quality	DIN ISO	Number	Remarque
	Between	And						
1	Intermediate flange	Top Cone	Bolt	M 48 x 330	IS:1364-1		72	Torque: 1400 Nm
			Nut	M 48	IS: 1364-3		72	
			Washer	B 48	St-A2E	125	72	
			Washer	D 100/55x15	Ck35	DIN EN 10278	72	
			Bolt	M39 x 200	IS:1364-1		8	For leveling the flange
			Sealing ring	3912x30x10			4	To be welded for gas tightness
2	Chute transmission gear box	Top flange	Bolt	M 27 x 190	21CrMoV5-7		48	Torque: 450 Nm
			Nut	M 27	24 CrMo5		48	
			Washer	B 27	St-A2E	125	48	
			Washer	D 45/29x4	Cu		16	inside doors
			Square iron	20x20x50	St		16	inside doors
			Gasket	Ø 8 x 8 500 Total: 34 000			4 Rings	staggered placed overlapping 300 mm
			Paste	Box	Sealing compounds EPPLE HT + Thinner EPPLE II		8 Boxes 2 Boxes	Thinner only required if daytime temperatures are very high
3	Chute transmission gear box	Planetary gear box	Bolt	M 24 x 70	8.8	ISO 4017	12	Torque: 294 Nm
			Washer	B 24	St-A2E	125	12	
			O-Ring	Ø 429x6	NBR 70	DIN 3771	2	
4	Doors (2x) of chute transmission gear box (1037x995x35)		T Head Bolt.	M 24 x 120	8.8 A2E	261	24	
			Nut	M 24	8 A2E	ISO 4032	24	
			Washer	24	200 HV-A2E	ISO 7090	24	
			O-Ring	Ø 10x3512	Silicon endless	MVQ 70	2	to smear with grease

Pos.	Connection		Material	Seize [mm]	Quality	DIN ISO	Number	Remarque
	Between	And						
5	Doors (1x) of chute transmission gear box (1582x1560x40)		T Head Bolt.	M 36 x 120	8.8 A2E	261	24	
			Nut	M 36	8 A2E	ISO 4032	28	
			Washer	36	200 HV-A2E	ISO 7090	28	
			O-Ring	Ø 10x5568	Silicon endless	MVQ 70	2	to smear with grease
6	Bellow arrangement	Valve actuating unit	Bolt	M24 x 120	8.8 A2E	ISO 4014	19	Torque: 294 Nm
			Nut	M24	8 A2E	ISO 4032	19	
			Washer	24	200 HV – A2E	ISO 7090	38	
			Gasket	D1080/960/5	W3		1	Corrugated seal
7	Valve actuating unit	Material hopper	Bolt	M36 x 90	8.8 A2E	ISO 4014	24	Torque: 700 Nm
			Washer	36	200 HV – A2E	ISO 7090	24	
			O-Ring	4441x18	MVQ 70	DIN 3771	1	
			O-Ring	4455x18	MVQ 70	DIN 3771	1	
8	Weigh beams		Bolt	M20 x 100	8.8 A2E	ISO 4014	16	
			Bolt	M20 x 20	8.8 A2E	ISO 4014	16	
			Washer	20	200 HV – A2E	ISO 7090	32	
			Bolt	M16 x 120	8.8 A2E	ISO 4762	16	Torque: 170 Nm
			Dummy				4	To use for installation
			Square	15 x 70	S235JRG2		16	
9	Bellow Arrangement	Material hopper	Bolt	M36 x 130	8.8 A2E	ISO 4017	24	Torque: 700 Nm
			Nut	M36	8 A2E	ISO 4032	24	
			Washer	36	200 HV – A2E	ISO 7090	24	
			O-Ring	1410x8	MVQ 70	DIN 3771	1	
			O-Ring	1355x18	MVQ 70	DIN 3771	1	
10	Upper seal valve casing	Bellow arrangement	Bolt	M36 x 130	8.8 A2E	ISO 4017	24	Torque: 700 Nm
			Nut	M36	8 A2E	ISO 4032	24	
			Washer	36	200 HV – A2E	ISO 7090	24	
			O-Ring	1370x18	MVQ 70	DIN 3771	1	

Part 6 – Erection

Main connections at the BLT assembly



5.5 TRANSMISSION GEAR BOX/TOP RING: SEQUENCE OF BOLT TIGHTENING

The threads should be smeared with paste MOS_2 (or a similar product) prior the erection.
Tighten bolts according to crossover method. This insures true bearing over the flange face and reduces stress on flanges and seal.

- first set nuts finger-tight
- first run 50% of the indicated torque
- second run 80% of the indicated torque
- third run 100% of the indicated torque
- after the leakage test (if any)

Installation procedure of the gasket “CERAVAL”:

- ensure that the contact surface of the flange is clean (free of grease and dust).
- apply a thin uniform film of paste on the flange
- embed the 4 seal rings into the paste, start with the outer ring (place the seal as close as possible to the bolts holes.
- the 4 rings should be placed at an equal distance between each other. Gape approx.10 to 15 mm between each ring
- the 4 joints of the seals should to be staggered by 90°
- each joint must be positioned with an overlapping of 300 mm. At the overlapping the seal ends must touch each other.
- once the seals have been positioned, coat the entire surface again with a thick layer of the paste.
- lower down the transmission gear box onto the top flange. To prevent any lateral movement of the transmission gear box when touching the seal, the transmission gear box has to be guided. For this purpose minimum 3 pointed round bars of Ø 25 x 500 mm should be used. (bore in gear box flange Ø 30 mm)

Planetary gear box/Transmission gear box: Sequence of bolt tightening
The threads should be smeared with paste MOS_2 (or a similar product) prior the erection.
Tighten bolts according to crossover method. This insures true bearing over the flange face and reduces stress on flange and gasket.

A retightening of the bolts must be applied after the leakage test

5.6 ASSEMBLING PROCEDURES

Assembly of bell-less top charging device

It is important to follow this installation procedure to ensure good operational and maintenance results.

General

Prior to installing the new Paul Wurth Bell Less Top equipment, the old Totem charging distributor with lower valve casing must be removed. All old platforms which will no more be needed for maintenance works on the new Bell Less Top should already be replaced before the shutdown.

All platforms which have to be replaced were defined during basic engineering.

Erection sequence:

1. Install intermediate flange
2. Define height about which the upper seal valve casing and receiving hopper must be lifted. (dimension between top flange and lower flange of upper seal valve casing must be 9228mm)
3. Lift receiving hopper with upper seal valve casing to new position.
4. Install new supports for receiving hopper.
5. Install new weighing system on material hopper.
6. Install bellows arrangement between material hopper and upper seal valve casing.
7. Finalize the erection of the new platforms.
8. Finalize the installation of the new dismantling monorauils.
9. Install chute transmission gear.
10. Install valve actuation unit.
11. Finalize modifications on equalizing system.
12. Install distribution chute

Important Note

Because the commissioning of the hydraulic and electric equipment is critical, care has to be taken that units as:

- the hydraulic room
- the lubrication
- the transmission gear
- the seal valves and material gates
- the pressure equalizing valves

may be commissioned and tested at any time before main shut down.

5.7 PREASSEMBLING ON THE GROUND

To save time, the following equipment should be assembled in the workshop

5.7.1 Assembling of Valve Actuation Unit

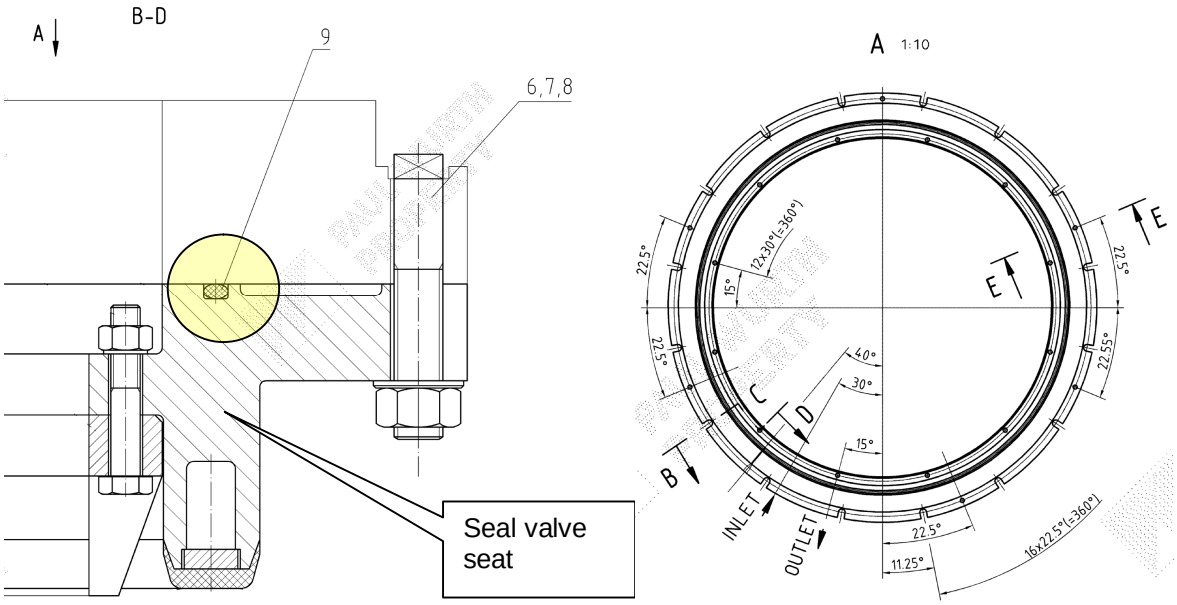
- Install the spherical material gates complete with wear plates according to the maintenance manual section 7, chapter 3.2.
- Install the material gate drive with counter bearing according to the maintenance manual section 7, chapter 3.4.
- Install the seal valve drive according to the maintenance manual section 8, chapter 3.12.
- Install the seal valve seat according to the maintenance manual section 8, chapter 3.3.
- Install the seal valve flap according to the maintenance manual section 8, chapter 3.11.
- Install the protection ring of the seal valve seat according to the maintenance manual section 6, chapter 3.4.
- Install the insertion funnel according to the maintenance manual section 6, chapter 3.3.
- Install the piping for the steam heated seat and the greasing of the counter bearing.

Before erection, a functional test should be made. Therefore a hydraulic pump station should be available in the workshop to move the material gate drive and seal valve drive. Special care must be taken to check if the seal valve seat is well centered to the seal valve flap.

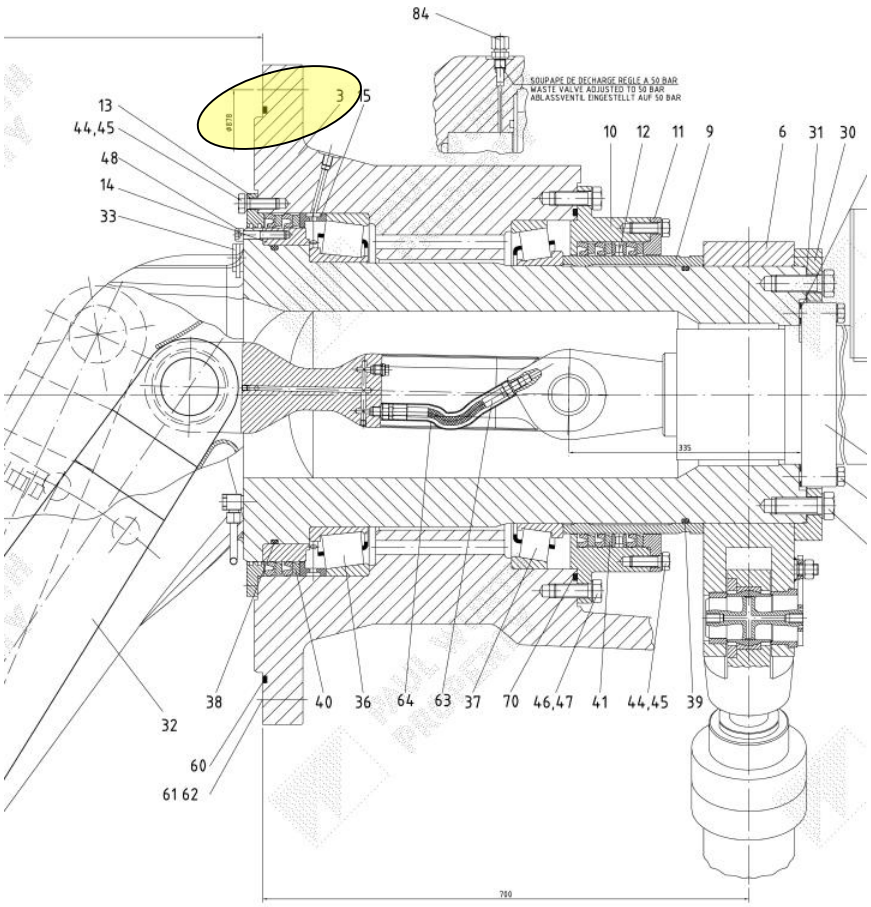
The upper seal valve drive with the flap and the seat should be installed in the workshop.

To install the drive the rig can be used. The installation is also possible with a crane only.

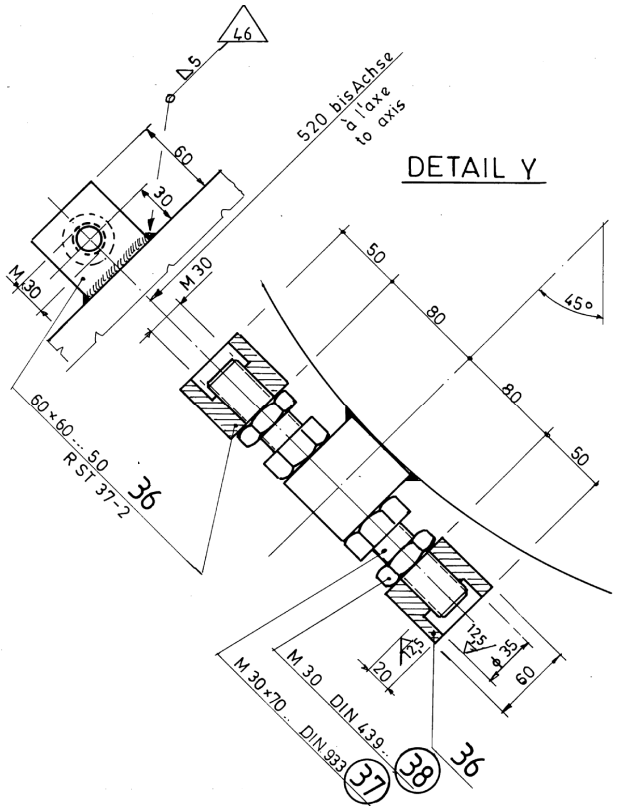
Installation of the O-Ring for seal valve seat and drive:



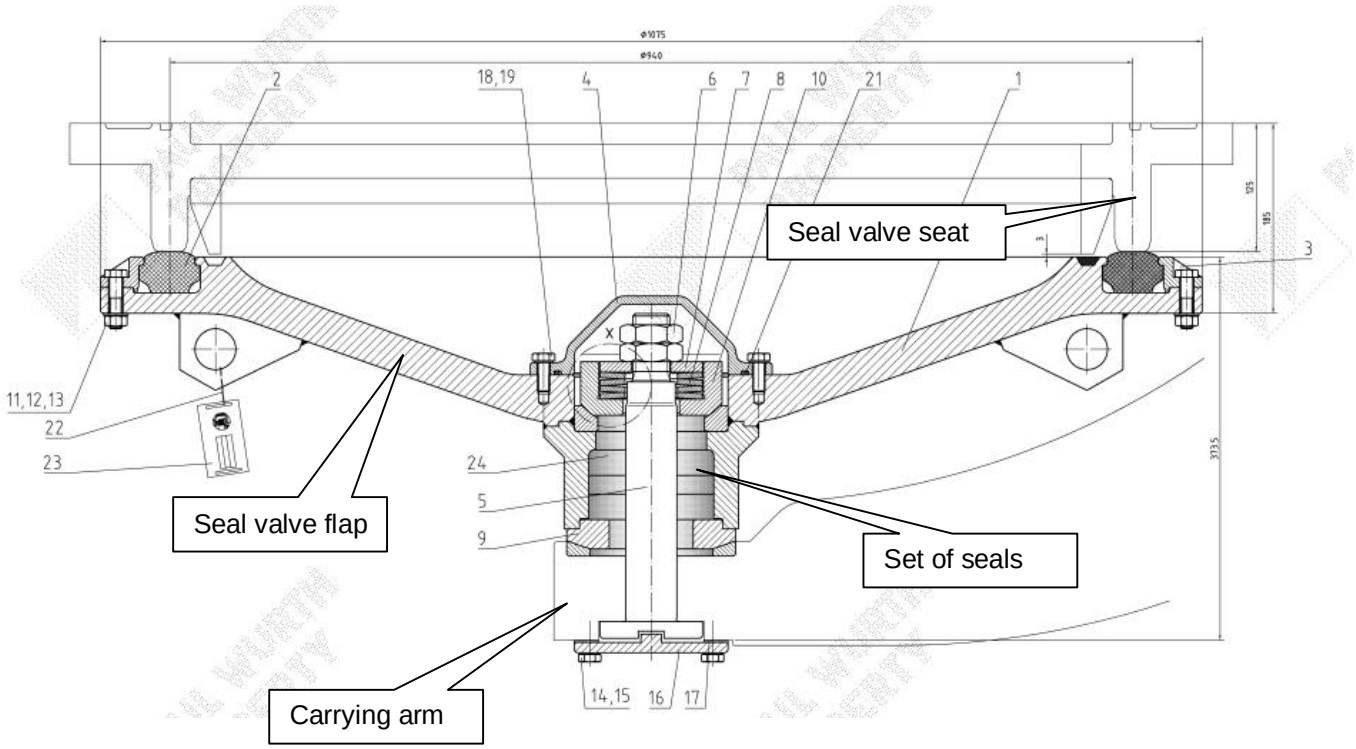
Make sure that the silicon O-ring 946 x 8 mm (Pos. 9) has been installed in the groove



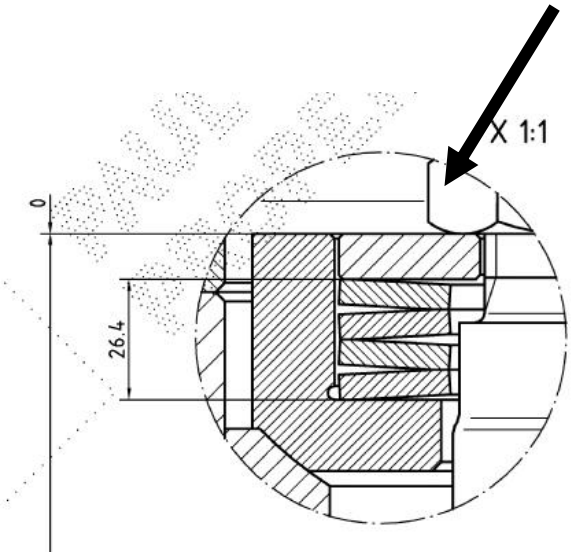
After the installation of the seal valve drive: tighten the bolts Pos. 37 against the torque bracket and tighten firmly the nuts Pos. 38 to secure the bolts



Seal Valve flap suspension:

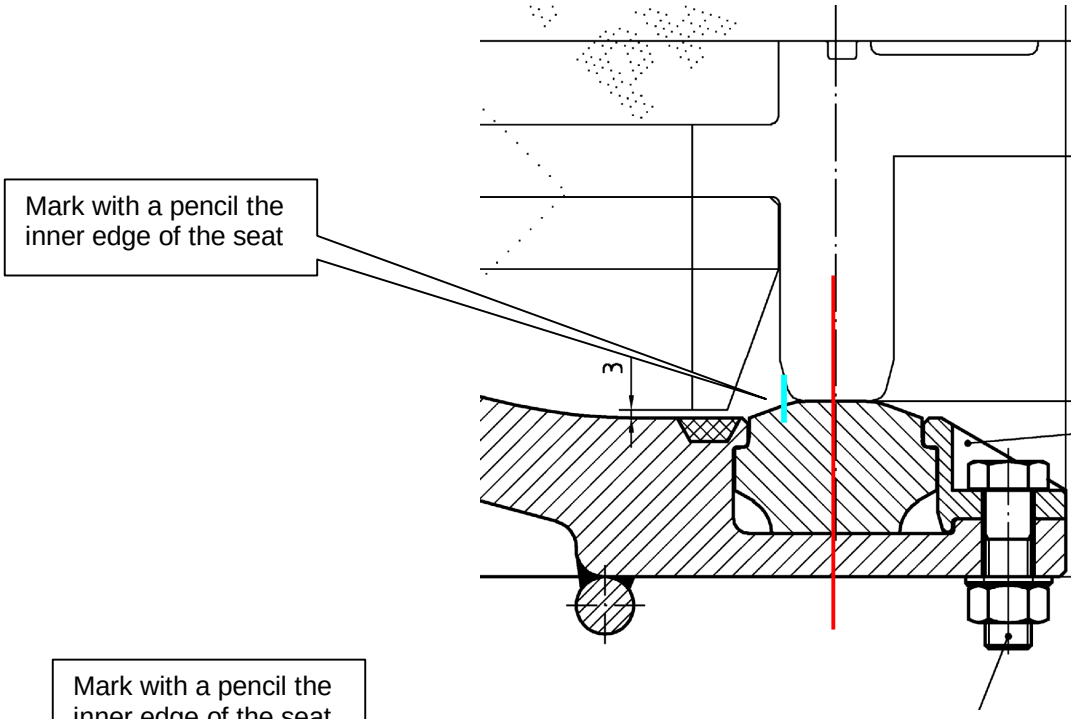


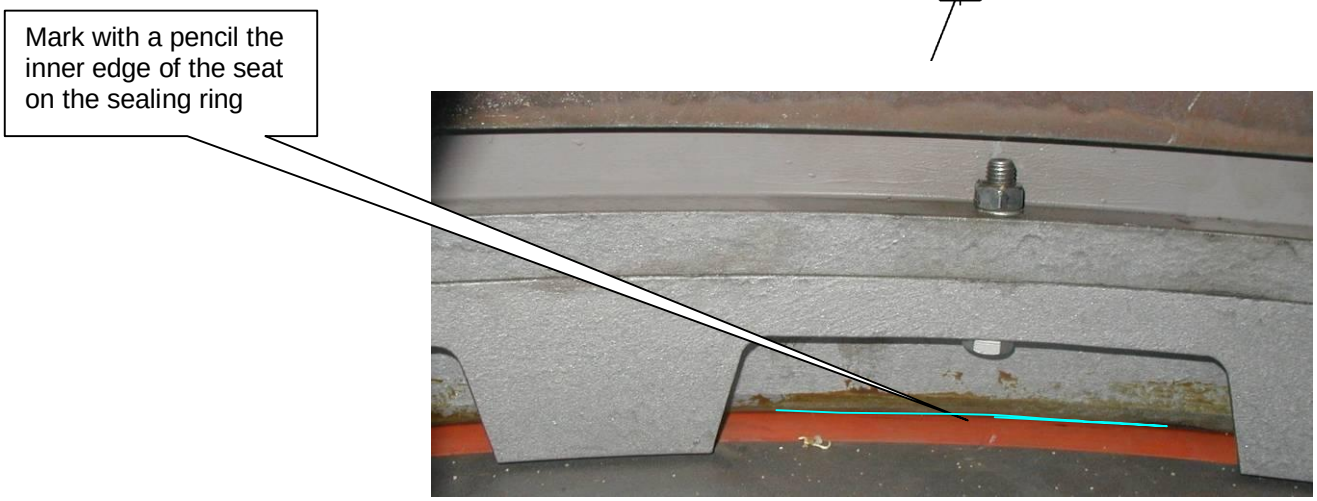
Compress spring washers until the surface of the pressure washer is flushing with the bearing shell



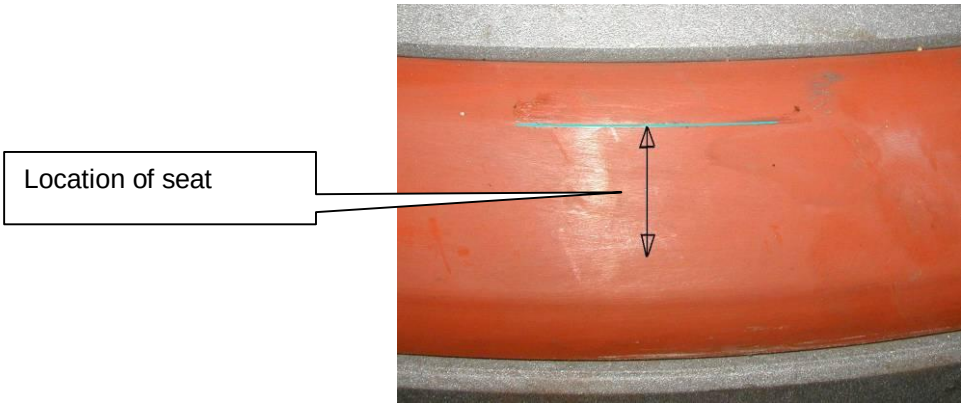
To prevent dust accumulation in the spring area the set of seals must be installed

The valve should be operated with a hydraulic power unit and the centering of the seal and the seat must be checked





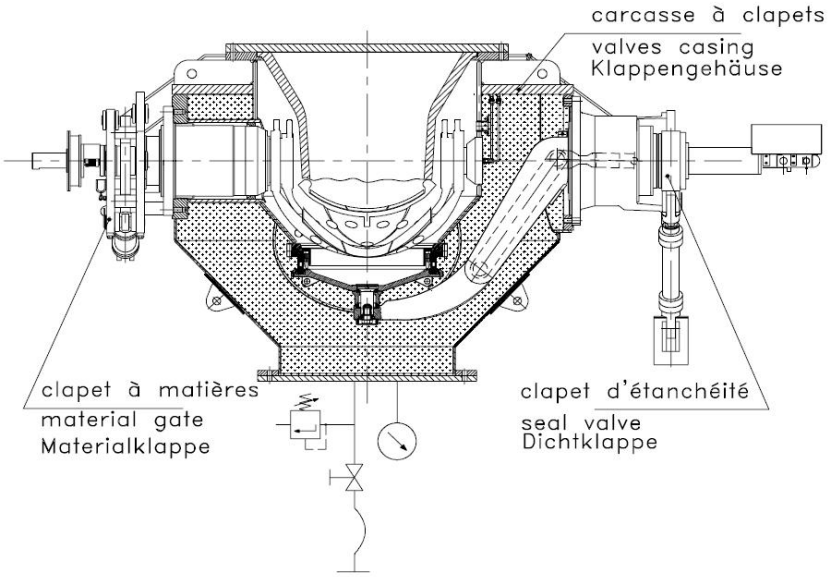
Check the correct centering of the seat in relation to the sealing ring



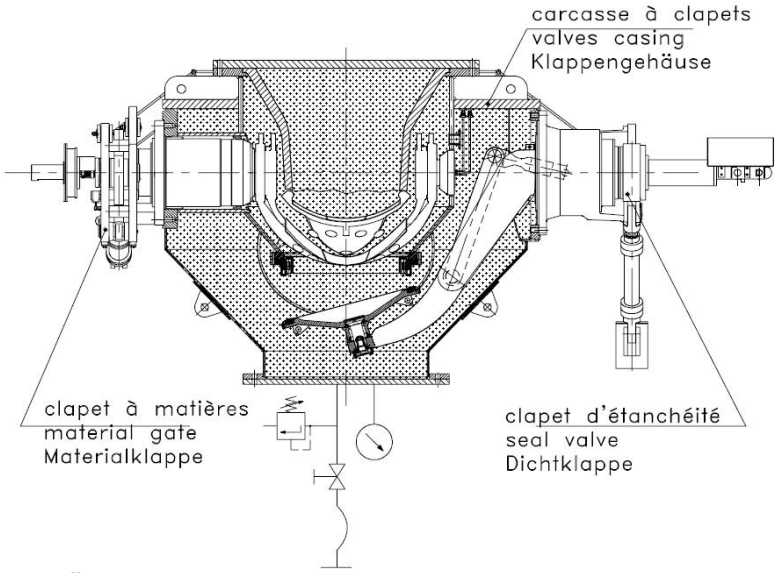
A tightness check of the valve actuation unit should be done in the workshop

- *Assemble the valves actuation unit, grease and connect the drives of the valves to the hydraulic unit.*
- *Carry out the functional controls while actuating manually the gates.*
- *Close the sealing gate and obturate the openings of the valves casing.*
- *Connect the compressed air to the valves actuation unit.*
- *Pressure up the lower chamber of the valves actuation unit gradually to the control pressure value of 275 [kPa] (sketch N°1).*
- *Tightness control by means of soap water after 2 hours.*
- *Release the pressure from the lower chamber of the valves actuation unit and open the sealing gate.*
- *Pressure up the valves actuation unit gradually to the control pressure value of 275 [kPa] (sketch N°2).*
- *Tightness control by means of soap water after 2 hours.*
- *Release the pressure from the valves actuation unit.*

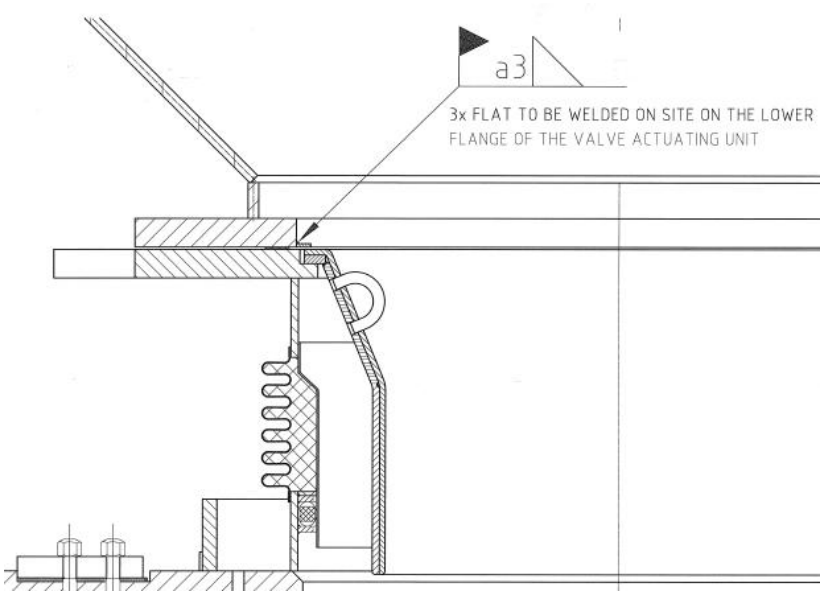
Croquis N°1
Sketch / Skizze



Croquis N°2
Sketch / Skizze



Installation of the insertion funnel inside the valve actuation unit:



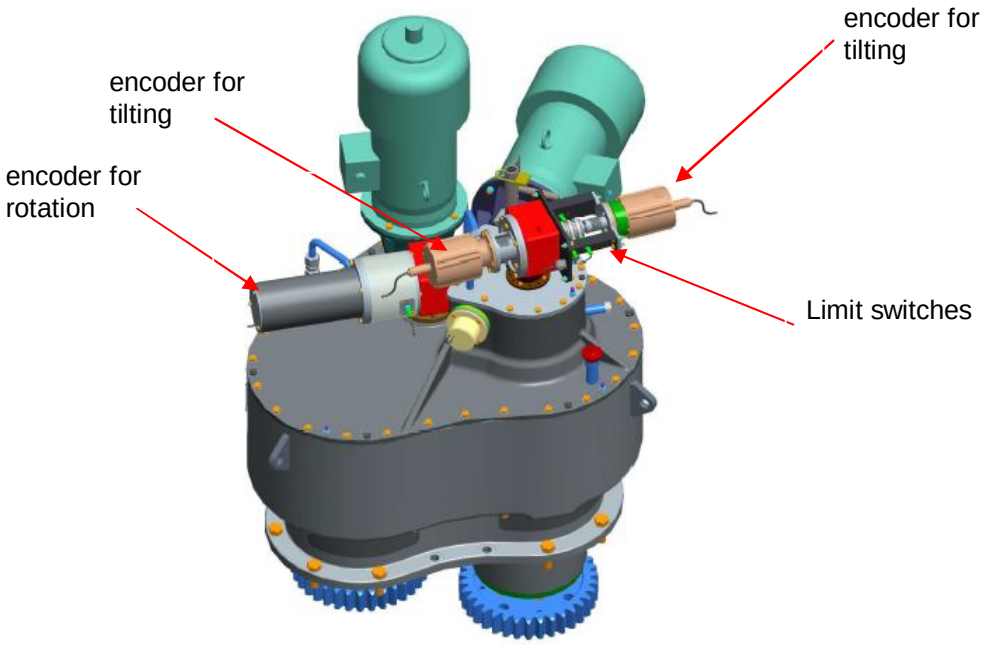
3

5.7.2 Planetary gear box

Installation of the planetary gear box on the chute transmission gear box

Clean the sealing surface on the chute transmission gear box and install O-Rings in groove

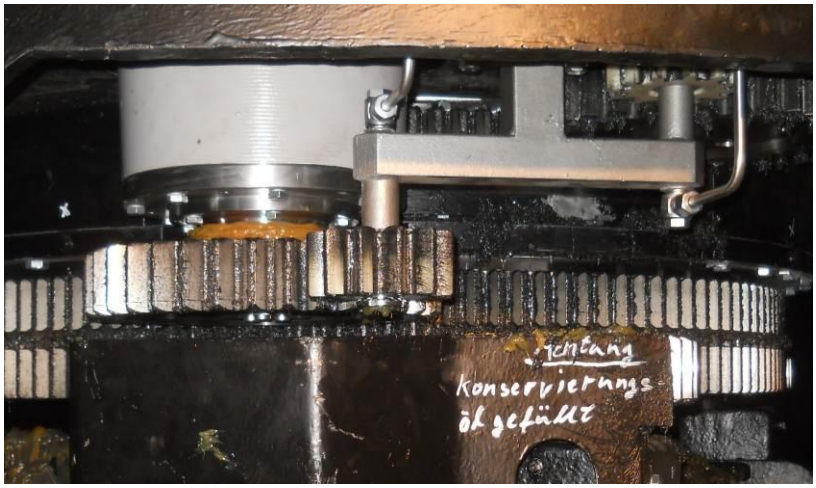
Lift the planetary gear box and install it



Install encoders and limit switches on intermediate gears. Do not install electric motors

When the pinion shafts enter the chute transmission gear box the teeth most probably knock against the roller bearing slewing ring. By turning the shaft for the tilting the teeth on the pinion shafts can be orientated to allow the lowering of the planetary gear box

Install the piping of the greasing system on the planetary gear.
Install the greasing pinions.



5.8 ERECTION OF THE BELL LESS TOP EQUIPMENT

Note

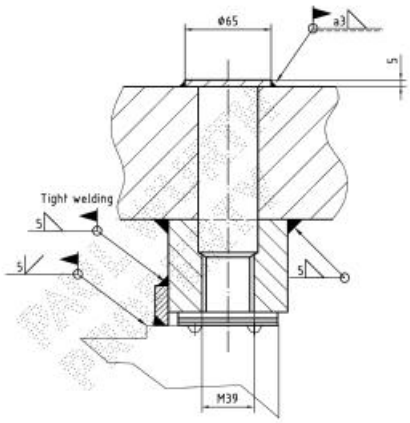
The erection of the new Paul Wurth Bell Less Top equipment should be done according to the engineering drawings 5019064-0439616 1/6 0, 5019064-0439616 2/6 0, 5019064-0439616 3/6 0, 5019064-0439616 4/6 0, 5019064-0439616 5/6 0, 5019064-0439616 6/6 0, showing all erection sequences.

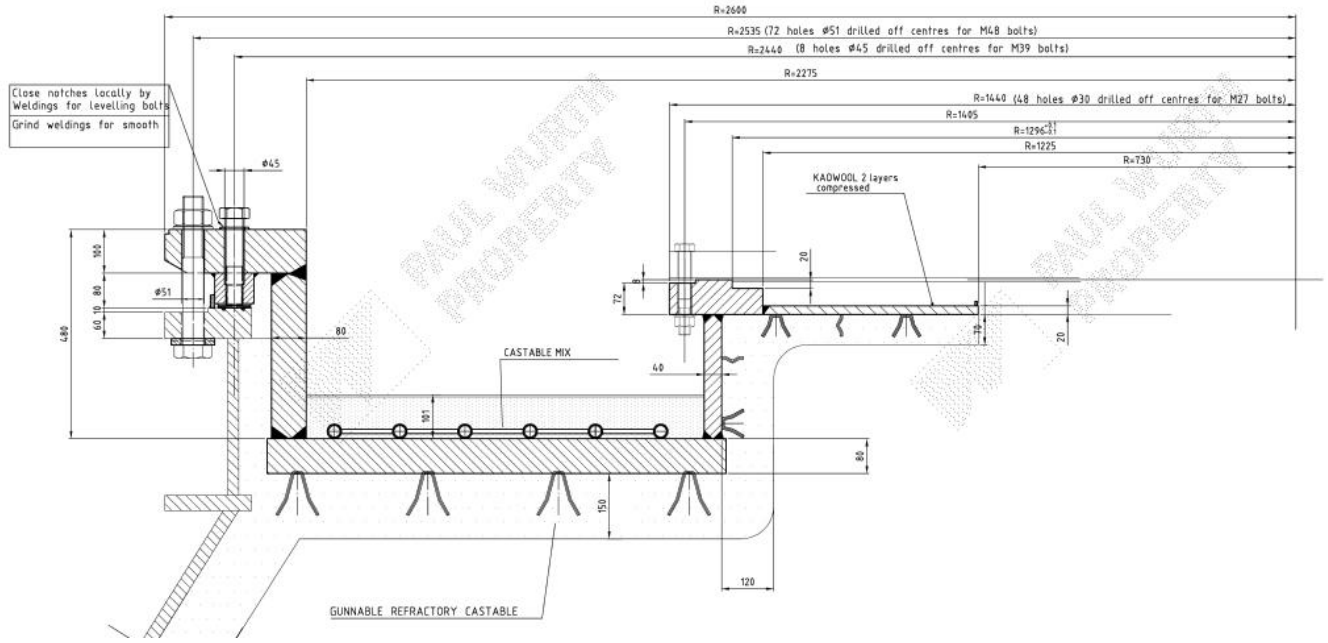
5.8.1 Intermediate Flange

The intermediate flange should be installed according to drawing 5019064-0434417 1/1 A

Procedure:

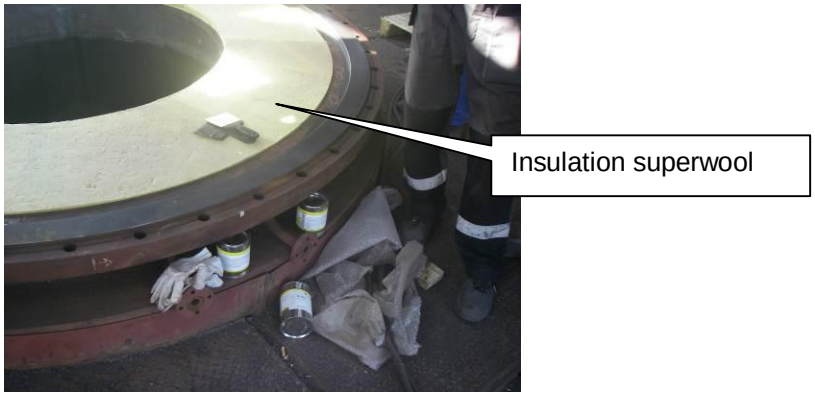
REMARK.
ERECTION PROCEDURE:
1) EXISTING SEALING RING TO BE REMOVED AND UPPER FACE OF B.F. FLANGE TO BE PROPERLY CLEANED.
2) CLOSE NOTCHES LOCALLY WELDING FOR LEVELLING BOLTS. GRIND WELDINGS FOR SMOOTH SURFACE
3) INSTALL INTERMEDIATE FLANGE AND CENTER ON CENTERLINES MARKED BETWEEN TOP CONE AND INTERMEDIATE FLANGE.
4) BY ADJUSTING THE 8 LEVELING SCREWS, THE FLANGE ASSY IS LEVELLED ON THE REQUIRED ELEVATION.
5) SHIM PLATES ARE THEN INSERTED AS REQUIRED.
6) POSITION SEALING RING BUT DO NOT WELD.
7) THE 8 LEVELING SCREWS TO BE REMOVED.
8) THE FLANGE ASSY TO BE SCREWED WITH EXISTING TOP RING: 36 BOLTS M48 TORQUE SETTING 300 Nm EACH SECOND BOLT.
9) CHECK INNER FLANGE FOR HORIZONTAL INSTALLATION: (FOR TOLERANCES SEE ERECTION MANUAL)
10) SEALING RINGS ARE THEN WELDED IN POSITION.
11) THE 8 HOLES OF LEVELLING SCREW TO BE CLOSED BY SEAL PLATE.
12) ASSEMBLE AND TORQUE CHECK REMAINING 36 BOLTS.
13) FINAL MACHINING OF BLT FLANGE. (FOR TOLERANCES,SEE INSPECTION DOCUMENT RC0182)



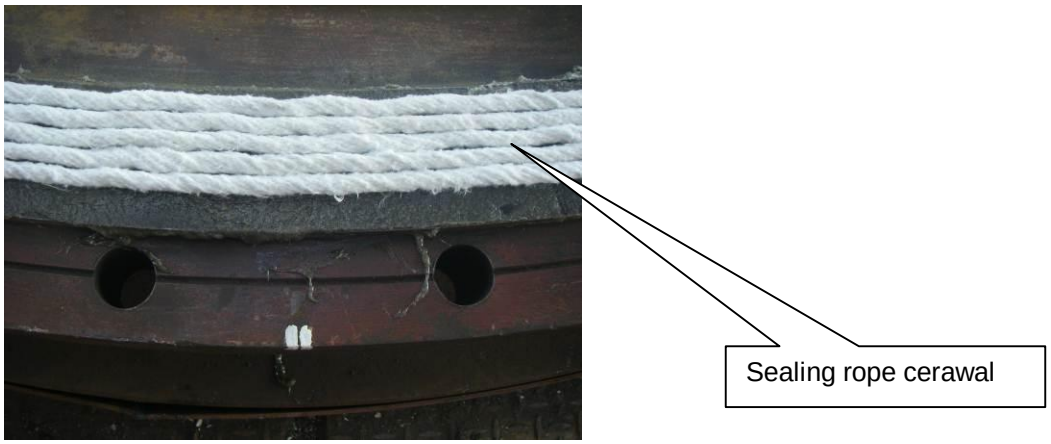


- Check the horizontality of the new top flange from the intermediate flange which will support the transmission gear. Following tolerances must be reached:

  - Admissible divergence in horizontal plane (slant), measured over full flange diameter: 1 mm.
  - Heavy waviness over the surface of the flange for a distance of 120° of the flange circumference, must not exceed ± 0,35 mm.
  - Short waviness over the surface of the flange for a distance of 30° of the flange circumference, must not exceed ± 0,25 mm.
  - The short waviness can however be superimposed on the heavy waviness.
  - Before installing the transmission gear the flange must be checked by the field engineers and the PW representative to ensure that the above mentioned tolerances were reached. Put all measured values to the acceptance report (Rc0181-1).



- Cut and install 2 layers (thickness 2 x 25 mm) of the heat insulation material on the refractory retainer ring



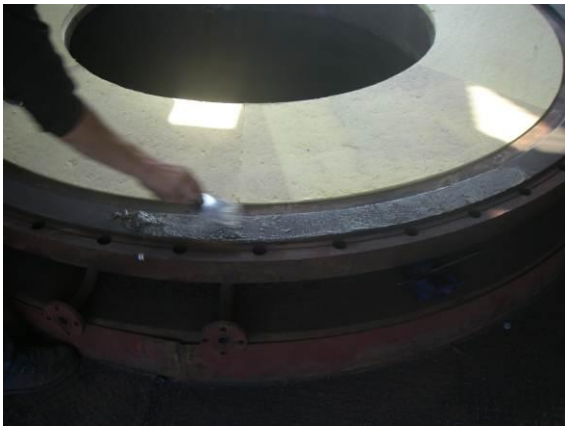
- Clean the connection flange of the casing on chute transmission gearbox and the top flange

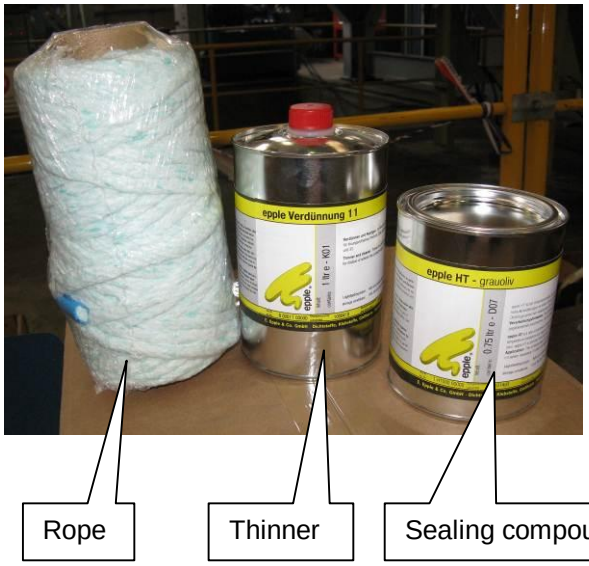
5.8.2 Chute transmission gear box

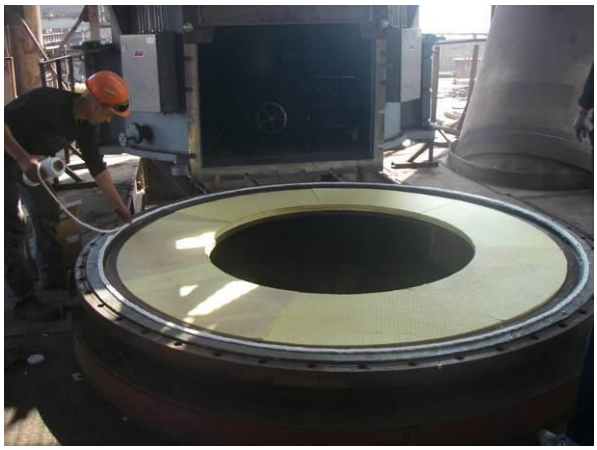
- Clean the connection flange of the casing on chute transmission gearbox and the top flange
- Lift the chute transmission gear box in a horizontal plane to the BF top platform
- Make sure that the gear box can be moved easily to the BF center before starting with the installation of the seal on the furnace top flange

- Install the sealing material on the furnace top flange

  - Apply a uniform film of the special sealing compound (Epple HT) to a thickness of 2mm on the mating surface of the flange
  - Install first sealing ring starting on the outer circumference

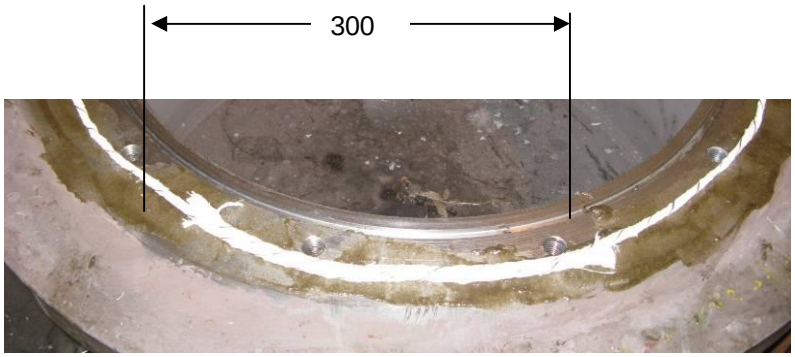






- Place 4 concentric rings of ceramic fiber rope (cord D8 Cerawal) in an interlaced pattern on the sealing surface of the top ring. Each of the 8 mm CERAWAL cord rings should have an over length of approximately 300 mm to allow the ends of the cord to be overlapped. Squeeze those overlapped ends of every single ring together. Cover the ceramic fiber rope with a top layer of jointing compound. The ends of the cord should be staggered so they are located on the top ring centre lines.

- Once the loops of cord are in position coat the whole surface again with a thick layer of the special sealing compound



Overlapping of 300 mm

Attention

Important Note

The sealing compound (Epple HT) is easily inflammable.
For this reason grinding and welding around and above the top flange must be stopped during the installation

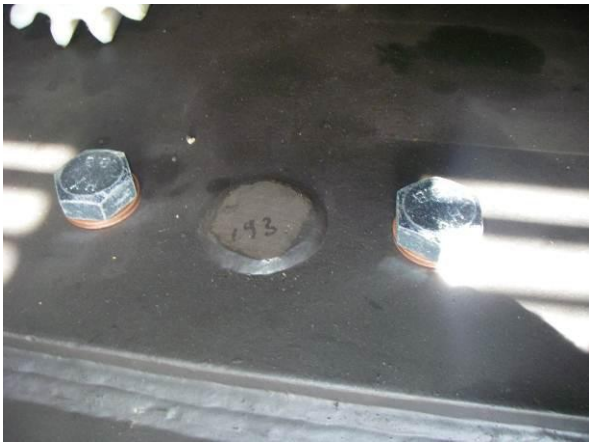
- Install the chute transmission gear box
  - Move the chute transmission gear box to the center of the BF

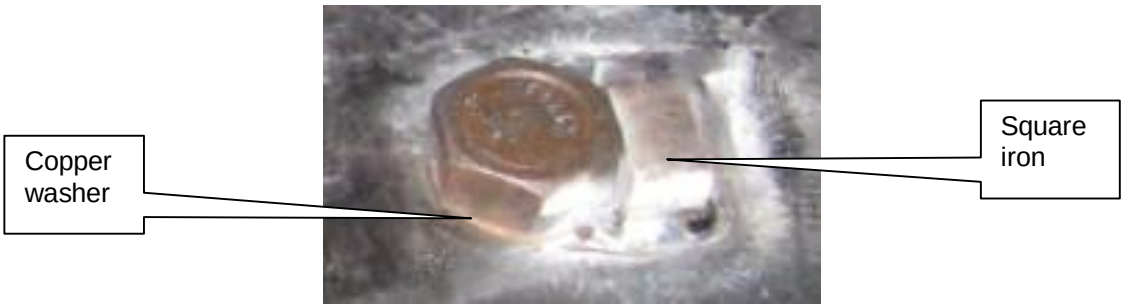
  - Install the 4 rods to center and orient the gearbox on the top flange

  - Insert all the bolts in the flange holes
  - Make sure that the axis on the gear box corresponds to the axis of the top flange
  - Lower the gear box and make sure that all the bolts are in line with the holes

- When the gear box is places on the top flange the bolts can be turned. This will make the tightening easier

- Inside the 2 main doors the head of the bolts must be located inside the gear box. There are 2 ways to make the bolt connection gastight.
  - Place the copper washer under the head of the bolt and secure the bolt by welding a piece of square iron to the gear box casing



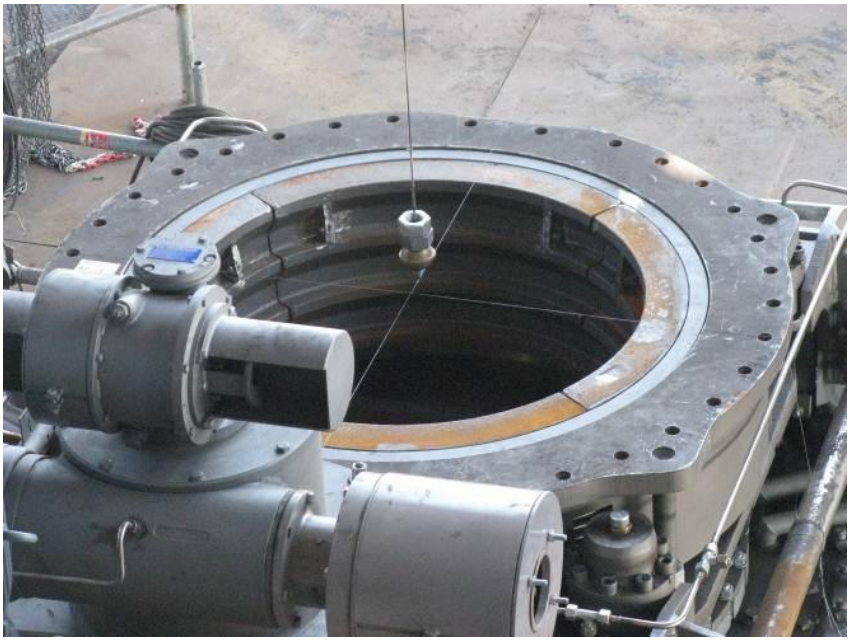


- Weld the head of the bolt gastight to the gear box casing. Remove the paint before installing the bolts

Head of bolt prepared for welding

Head of bolt welded

- Check once more the alignment of the material hopper and the expansion bellow.

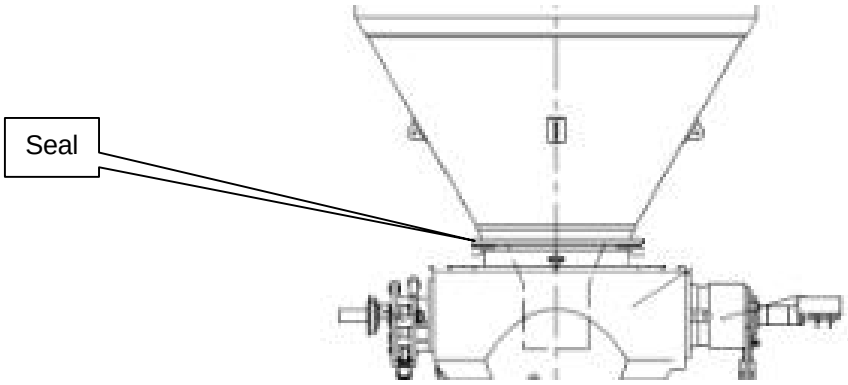


- Install all pipe connections: water nitrogen and greasing.

5.8.3 Valve casing

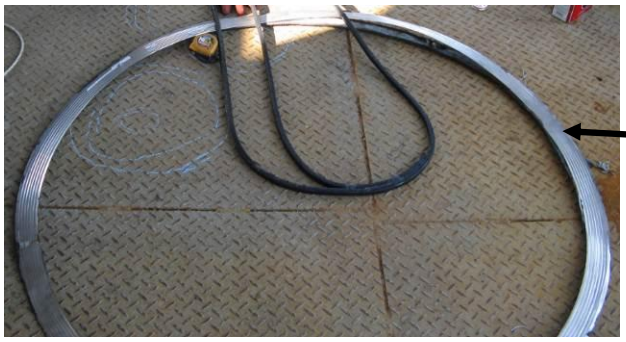
- Lift the valve casing and shift it to the BF center

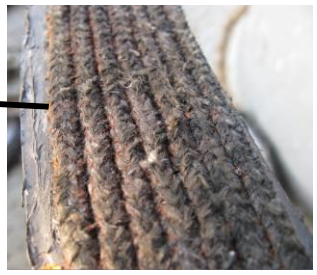
- Install the sealing material on the top flange of the valve casing. The procedure is identical to the one used on the top flange
- Lift the valve casing with several long bolts and bolt it to the material hopper. Ensure that when connecting the 2 flanges, there is no movement which could damage the seal



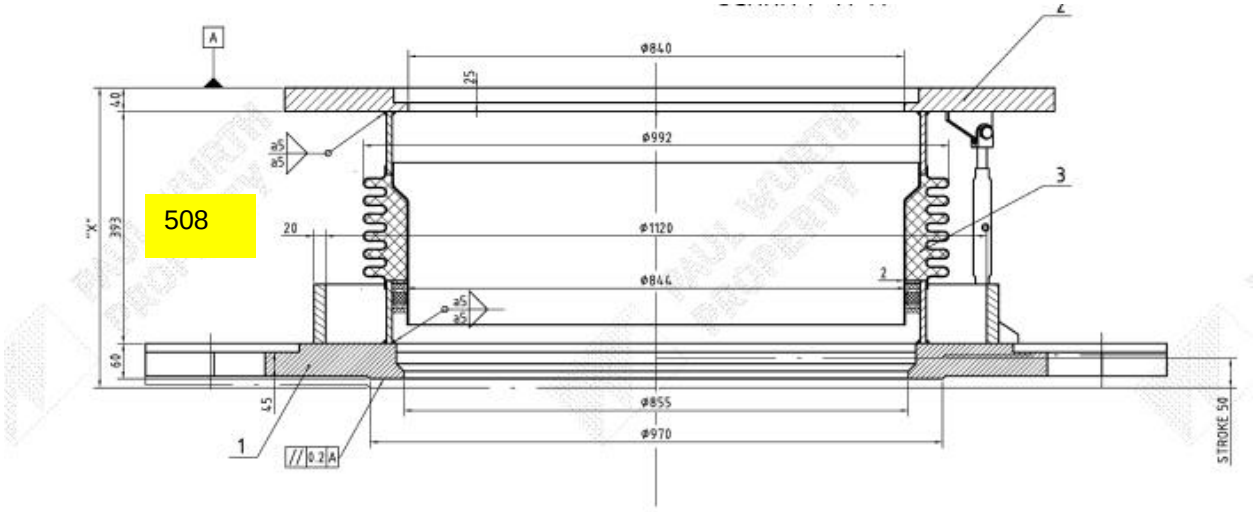
- Remove the 2 dismantling devices bolted to the valve casing

- Install and center the corrugated seal W3 (D1080/960/5) onto the upper flange of the expansion bellow





- Extend the bellow arrangement with the 4 guiding rods until the flange of the bellow touches the flange of the valve casing
- Insert the bolts and connect the 2 flanges
- After connection the distance X between the upper and lower flange should be 508 mm. Check this dimension on the 4 axis



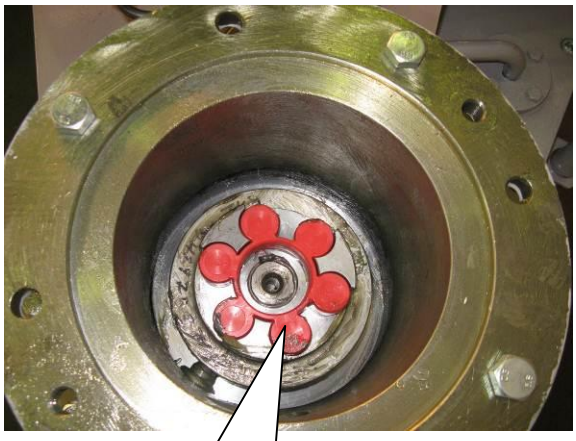
- Remove the 4 guiding rods.

5.8.4 Installation of electric motors

The electric motors for rotating and tilting can be installed on the ground or on the furnace. For this installation it may be better to install the motors only on the blast furnace.

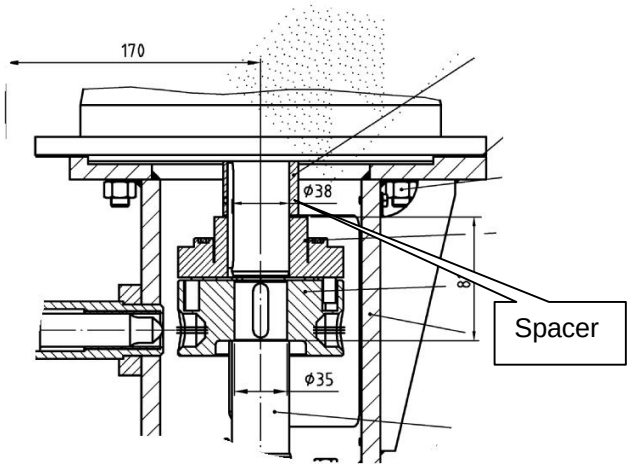
The position of the terminal boxes should be chosen in a way to make the cable rooting as easy as possible

Make sure that the elastic intermediate ring and the correct spacers are installed on each coupling

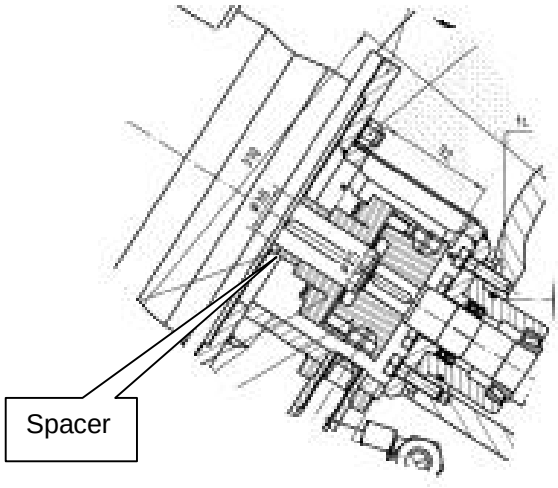


Elastic intermediate ring

Elastic intermediate ring



Rotation



Tilting

5.8.5 Installation of the load beams

- When all the assembly and welding works in the area of the material hopper and BLT area have been completed, the installation of the 3 load beams can start.
- By means of a hydraulic jack of 20to capacity, to be placed in front of the dummy, the hopper is lifted in order to create some space and enabling a replacement of the dummy by the load cells.
- After the assembling of the first load beam, the second, the third and the fourth can be installed as described above.
- As soon as the load cells are installed, copper ground cables, for each load beam, have to be installed in order to short circuit the load beams for preventing damages to the load cells by welding currents.

5.8.6 Lubrication

Lubrication

Fill in oil

➢ Planetary gearbox	115 l	SHELL OMALA 150
➢ Both intermediate gears	±1,5 l each	SHELL OMALA 150
Chute angle adjustment gearboxes : in the transmission gearbox housing	22 l each	SHELL OMALA 320

5.8.7 Greasing

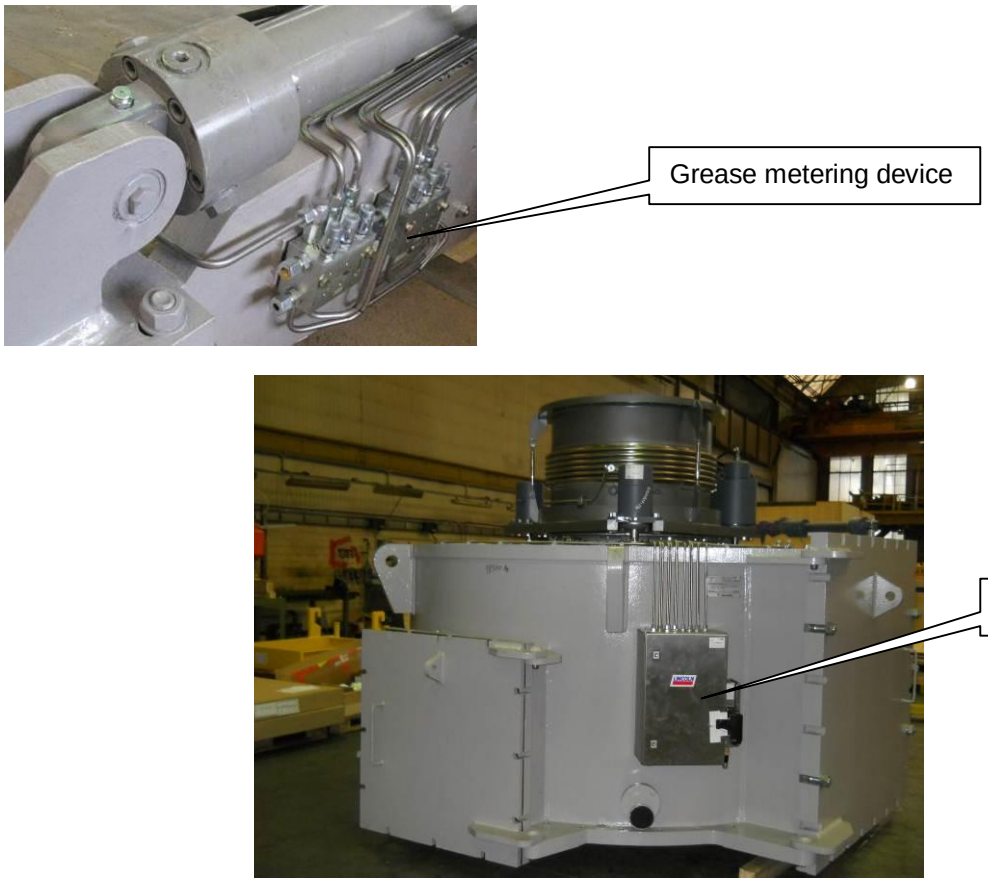
The system consists of two different greasing cycles. The two greasing cycles are driven independently by means of four 3/2-way valves.

Cycle I: every 45 minutes (chute transmission gear box 21 points, planetary gear 4 points, lower seal valve 1 point, lower material gate 6points, additional greasing points for old Totem equipment)

Cycle II: every 8 hours (lower seal valve 11 points, lower material gate 13 points, additional greasing points for old Totem equipment), equalizing valves, relief valves and bleeders)

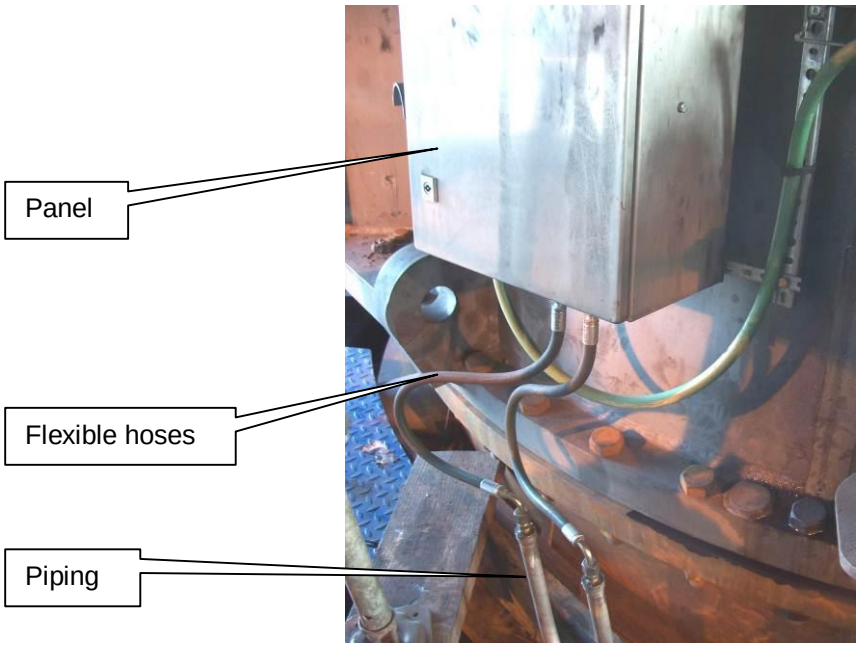
The two-line grease metering devices for the fast cycle are located in 2 panels bolted to the chute transmission gear box casing. The metering devices for the chute transmission gear box and the planetary gear box are equipped with limit switches. For the fast cycle on the other equipment no limit switches are foreseen
The two-line grease metering devices for the slow cycle are not equipped with limit switches.

- Connect the grease metering devices on the lower seal valve and lower material gate.

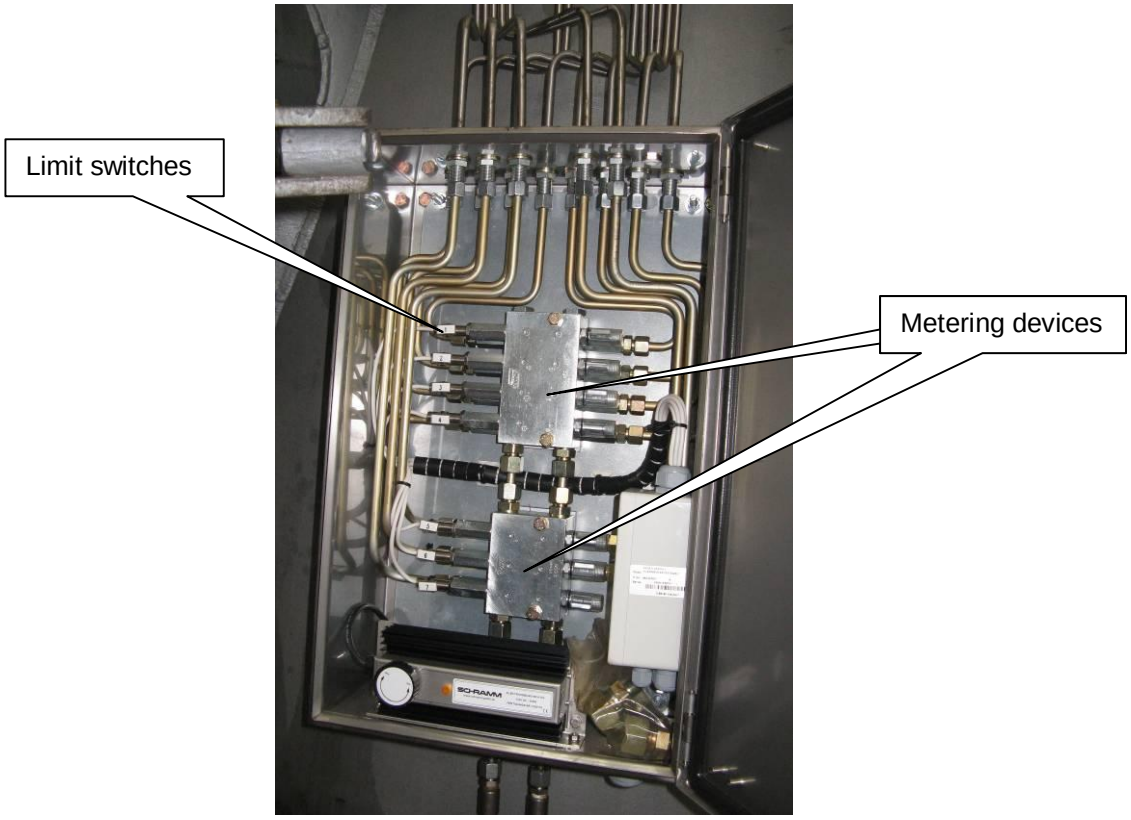


Chute transmission gear box

- Connect the 2 panels with the incorporated grease metering devices on the chute transmission gear box



The two-line grease metering devices for the fast cycle are on the chute transmission gear box and the planetary gearbox are equipped with limit switches.



5.8.8 Equalizing pipes

As soon as platforms and stairs are available and after the installation of the material hopper, the installation of the equalizing piping and the valves can start.

The equalizing and relief pipes have to be connected to the hopper. Care must be taken to install he pipe work without any pretention to the weighing hopper. Take special care to the correct alignment of the hinges of the articulated bellows.

To simplify the exchange of the relief valves, a compensator has to be installed according to the pipe guide drawing.

5.8.9 General piping

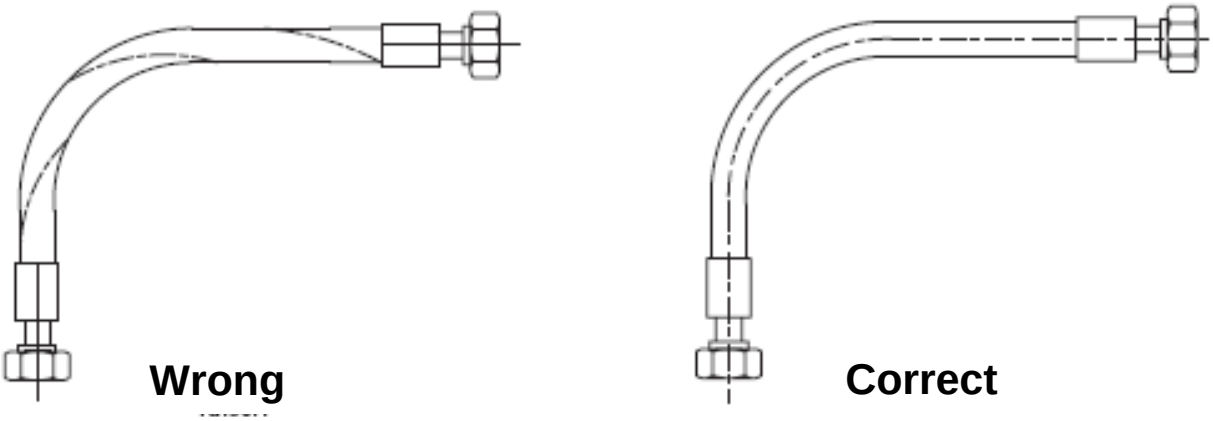
During the above described equipment assembly, the hydraulic power unit, the hydraulic valve panels and the water cooling system (inside room) may be installed at the erector's convenience prior to the bell-less top erection.

We recommend that the external piping concerning the hydraulics, the central lubrication and the water cooling system should not be completed until the final positioning of all the top equipments.

In this way, it is possible to keep the area clear around all equipments which may have to be moved during installation and maintenance work and to guarantee an easy access to all equipments.

High pressure hoses

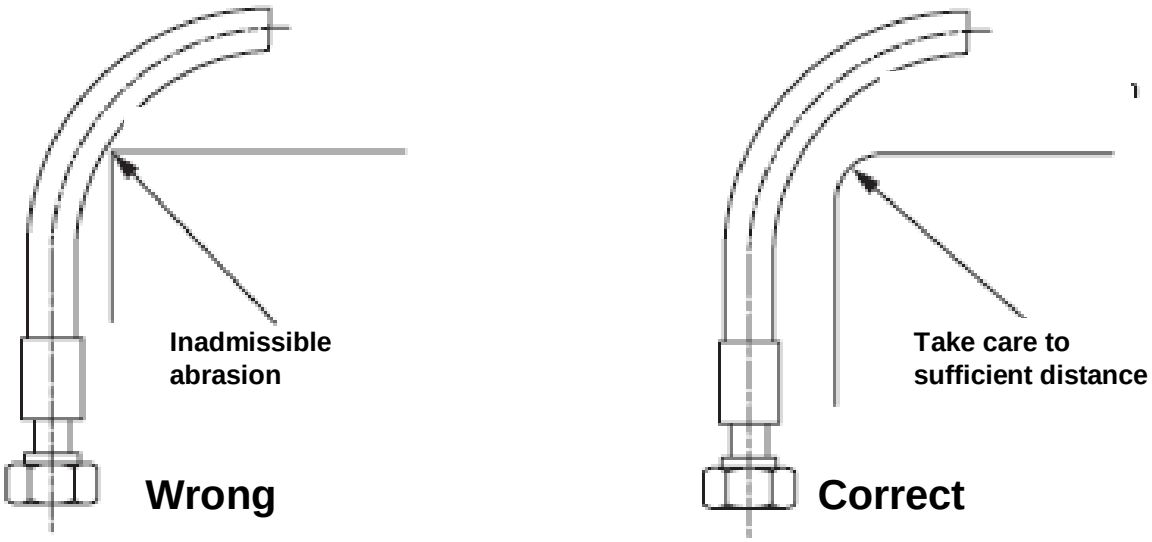
Torsion



While fixing of high pressure hydraulic hoses, special care must be taken to avoid torsion (twisting) of the hose. Block the solid part at the end fitting of the flexible hose by pipe pliers.

Reference value: a torsion of 7° only will reduce the lifetime of the hose by 80%!

Abrasion

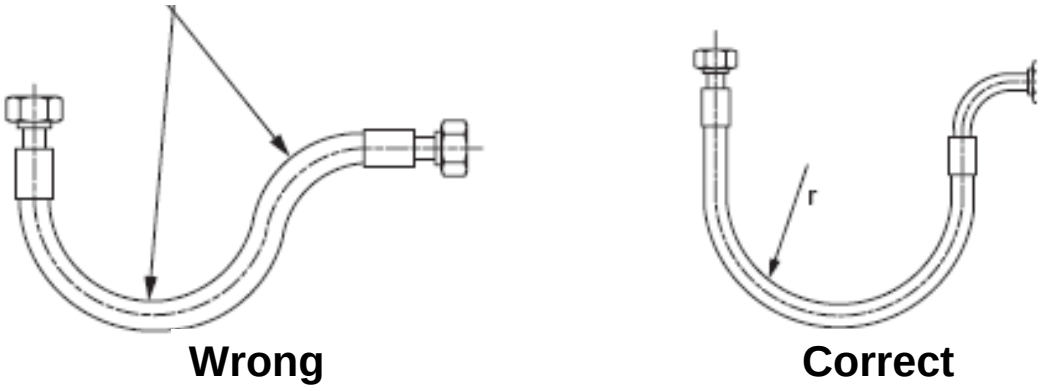


A flexible hose can be destroyed due to its proper motion while touching frequently sharp edges or similar in its surrounding.

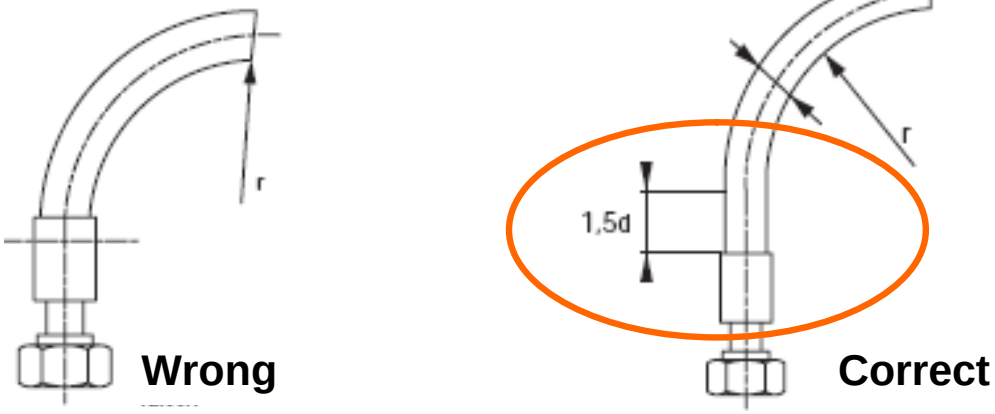
The same applies for two flexible hoses, touching each other.

Minimum bending radius while operation

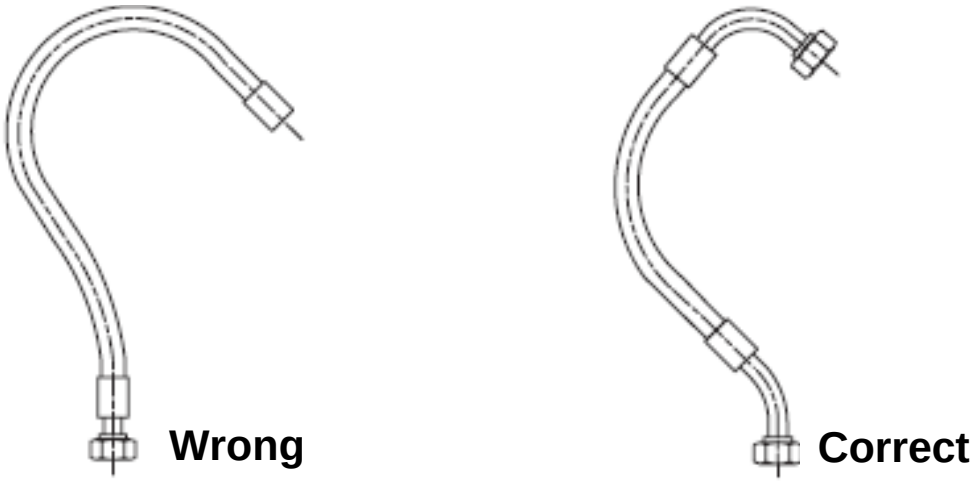
Bending radius too small



Bending radius too small

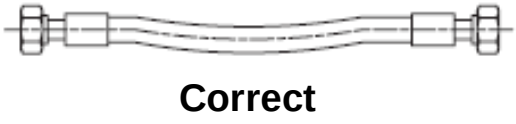


The bending of a flexible hose should begin after a straight section of about 1,5 x d (outside diameter of the flexible) In some cases, in order to avoid minimum bend radii, special connectors can be used.

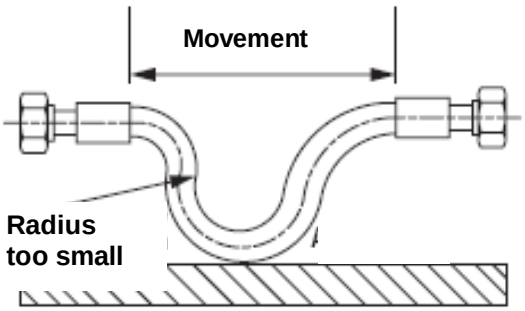


Tensile load

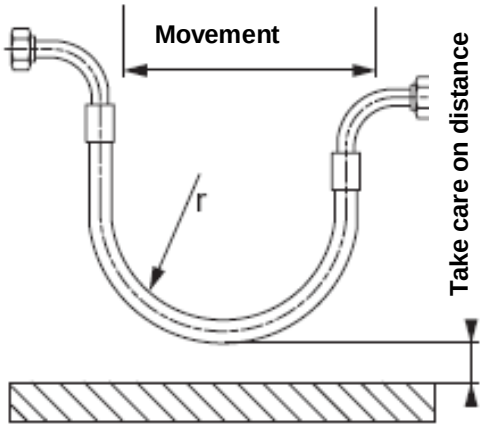
Wrong



Correct



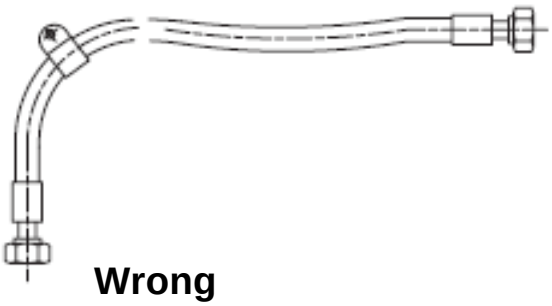
Wrong



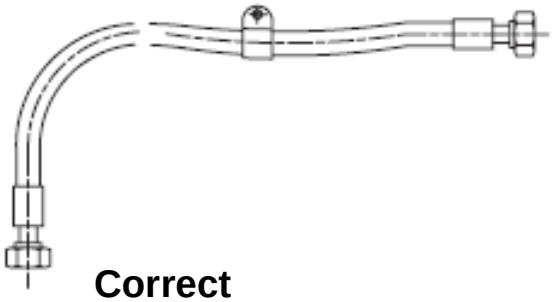
Correct

Tensile loads on flexible hoses are to avoided absolutely!

Flexible hose clamps



Wrong



Correct

In principle, fixations on the flexible hoses are to avoid. If clamps are used, they must be placed in a horizontal part of the flexible and not in the bend. Additionally, the change of the diameter is to consider. The fixation diameter must give enough space to the flexible.

5.8.10 Electrical and instrumentation

Similar to piping, all control panels, motor control centers and main conduit runs can be mounted and/or installed at erectors convenience prior Bell-Less Top erection. However, the assembly area around the furnace top equipment must be kept clear until the final positioning of the equipment is finished.

The end of the conduit runs should be located in such a way, that the areas are clear around the drive motors, cam limit switches, limit switches, encoder units, solenoid valves and gas reducers in case they have to be removed or replaced.

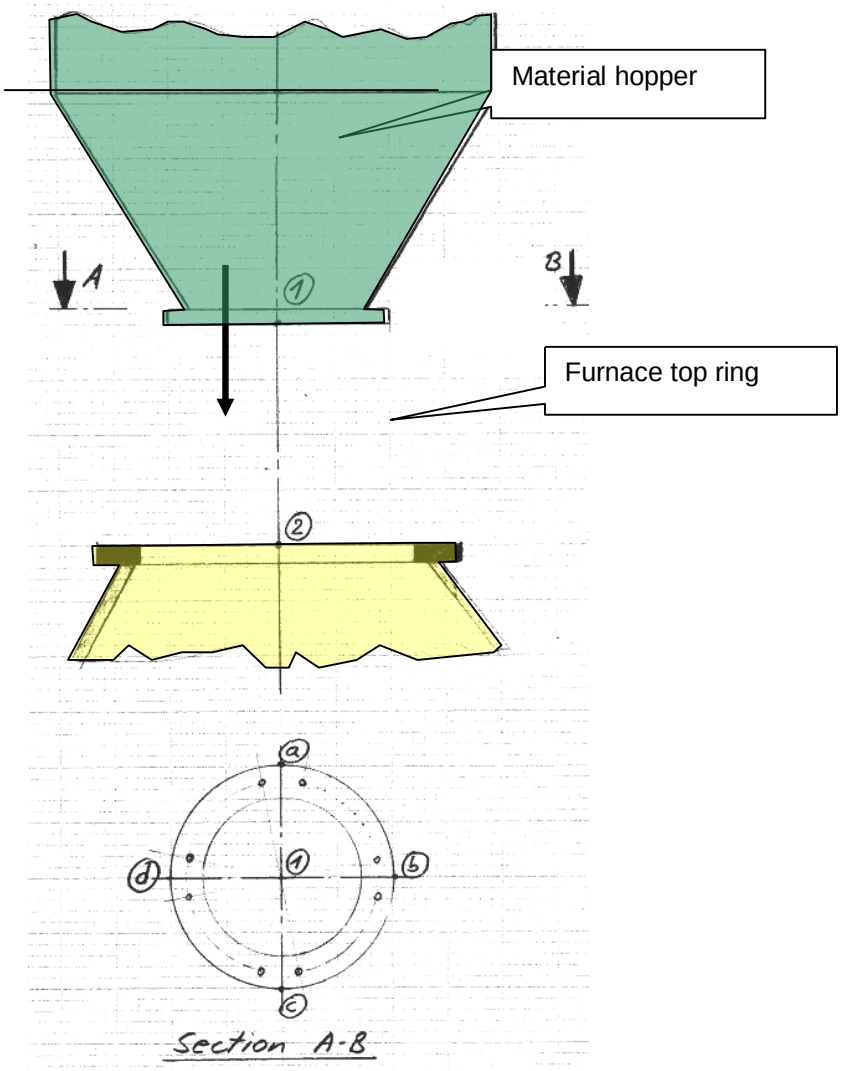
When all the assembly and welding work in the area of the material bin has been completed, the assembly of the load cells for the weighing hopper can be started.

5.9 ERECTION TOLERANCES

Note
One of the most important points to consider during furnace erection is the alignment of the furnace top and the charging equipment above the main transmission gearbox. Between the main transmission gearbox and the valve actuation unit is installed a bellow arrangement. This bellow arrangement compensates the axial and radial movements. The axial movements are the results of furnace growing due to thermal expansion of the shell. The lateral movements are mainly the results of wind load on the installation.
As the compensation of bellow arrangement, in axial (+15/-35 mm) and lateral (± 5 mm) directions is limited, the alignment during the erection of the blast furnace shell and the top equipment is of utmost importance.

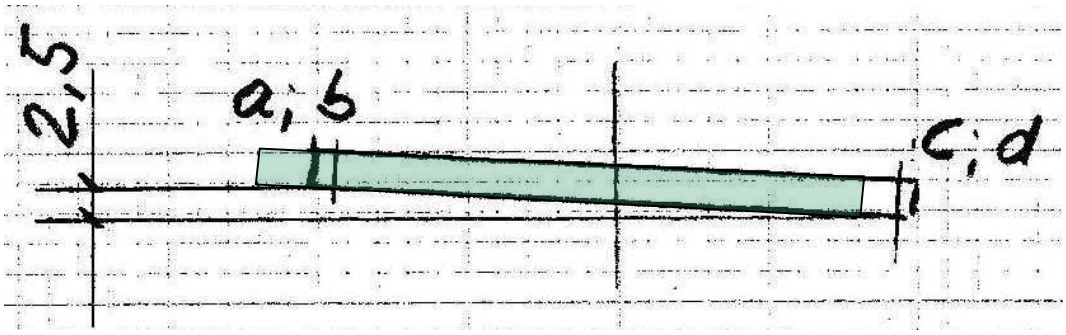
5.9.1 Tolerances

1. Checking of centre line
   The centre of the lower connecting flange of the material hopper should be brought down to the centre of the furnace top. The centre of the material hopper flange should be located within a circle of max. 5 mm diameter



2. Checking horizontality of the material hopper flange

   The level difference between the reference points a - c and b -d should not exceed 2,5 mm

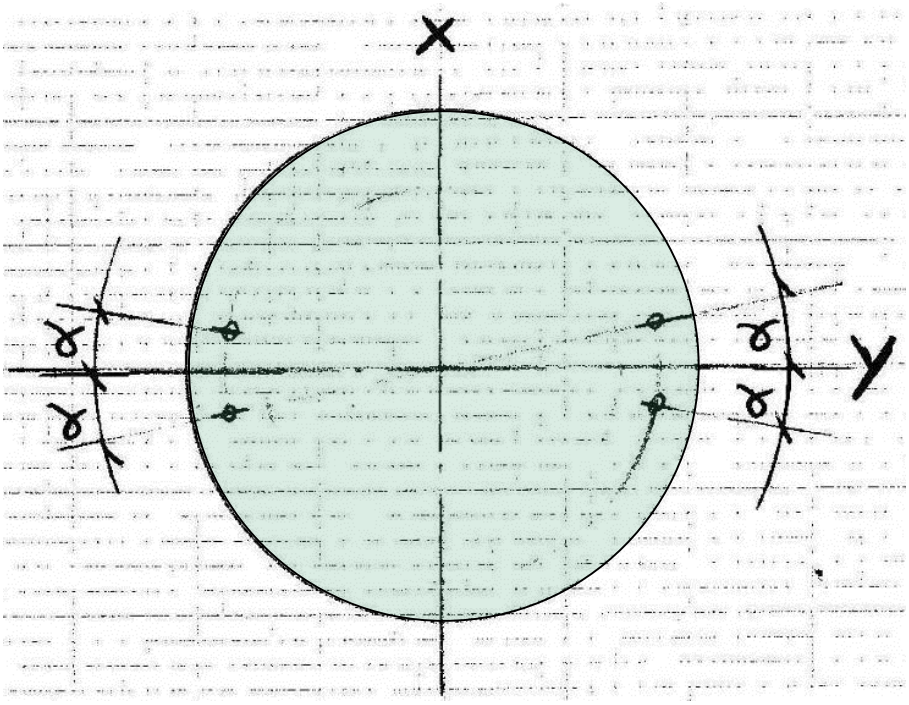


3. Checking horizontality of the furnace top ring

   The horizontality after erection should be ±1 mm

4. Checking alignment in relation to axis of the furnace

   The angle α between the holes in the lower material hopper flange and the axis x or y should not exceed ±0.05°



5.9.2 Installation of the intermediate flange

Adjust and bolt the intermediate flange to the old top flange.
Check the level +42315
Check the distance between the top flange and the flange of the material hopper. This distance should be 4418±3 mm
Check the distance between the top flange and the flange of the upper seal valve casing. This distance should be 9228±3 mm

The angle α between the holes in the furnace flange and the axis x or y should not exceed ±0.05°
Check the top flange according to the PW specific test report Rc 0181-1.doc. This document had already been transmitted. If necessary the flange has to be machined to match the indicated tolerances