

Day in the life of an operator

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10.23.2025

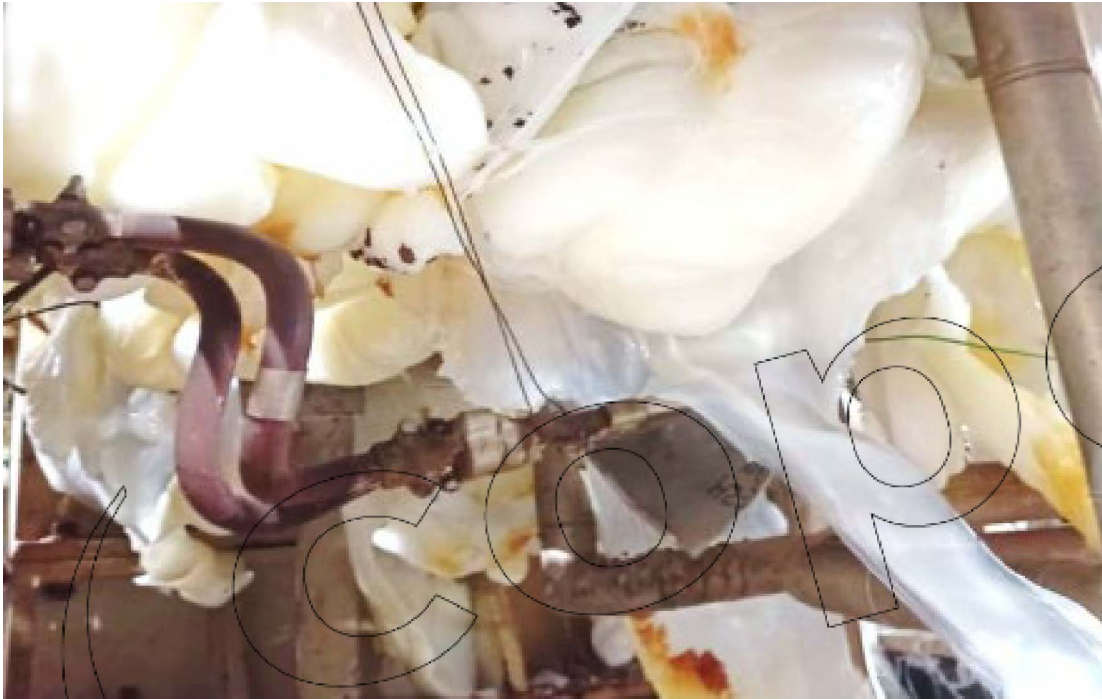
Agenda

A Day in the Life of an operator

- Tales from the field
- Extruder integrity
- Start up, shutdown, interlocks
- Inspection and reliability
- Coperion Aftermarket

Tales from the field

Polymer leaks



Polymer leaks due to improper torqued connections!



Leaks due to improper house keeping!

Gearbox damage



Shaft damage due to exceeded bearing lifetime!

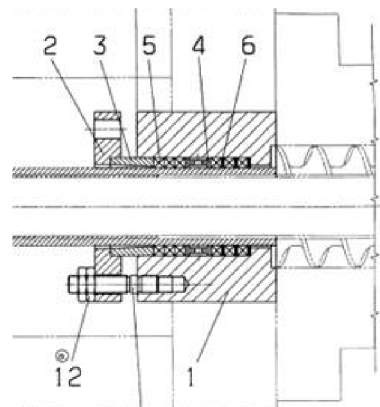
Powder or material leaks



Water leaks



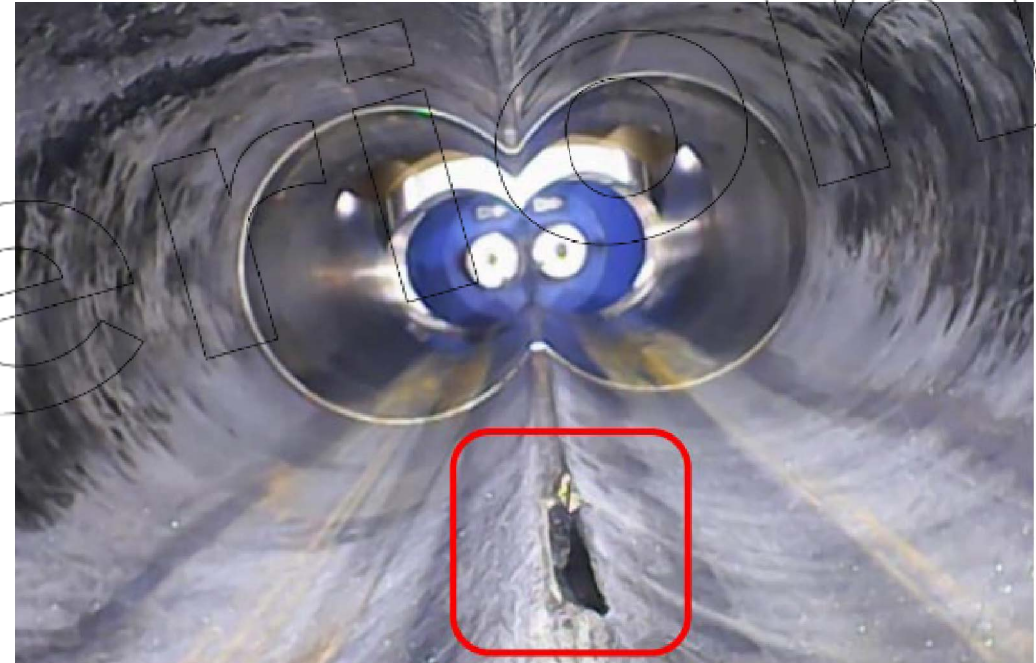
Sealing surface leaks



Overtorque



Abrasive and corrosive wear



Day in the life of an operator

- 1) Inspection and set up
 - Inspect the extruder and surrounding equipment for cleanliness and use
 - Review production schedules, screw configurations, and formulations for product run during the shift
 - Set up raw materials for feed, calibrate feeders, pumps, sensors, etc.
 - Review SDS as applicable
- 2) Start up procedures
 - Turn on the heat to barrels and allow to heat soak
 - Turn on gearbox lube oil pump
 - Once heat is soaked and the barrels are at desired temps., gradually start feeding and increasing screw speed in step increments
 - Complete the start up checklist
- 3) Production monitoring
 - Monitor parameters during production run-note any irregularities
 - Make adjustments as needed to maintain product quality and throughput rate
 - Adhere to safety protocols

Day in the life of an operator

- 4) Troubleshooting and maintenance
 - Troubleshoot any issues that arise during production
 - Follow PM schedule and perform maintenance for various equipment
- 5) Documentation
 - Log production data, process conditions, irregularities, etc.
- 6) Shut down
 - Ramp down the feed and purge the extruder
 - Prepare equipment for next shift

Extruder integrity

Extruder integrity

- Refers to overall condition and reliability of extruder's components during operation
 - Mechanical integrity-machine leveling, screw and barrel alignment, drivetrain alignment, base frame, pedestal supports, and levelling shoes are not corroded
 - Checking for leaks-screw shaft seal, gearbox seals, etc. should be tightened and replaced at periodic intervals
 - Lubricating rotating parts with appropriate grease
 - Replacement of worn parts such as barrels and elements to maintain product quality and throughput rates
 - Consistent operation-ensuring a uniform supply of feed, minimizing unexpected shutdowns

Keep your extruder in optimal condition!

Verify motor alignment to gearbox

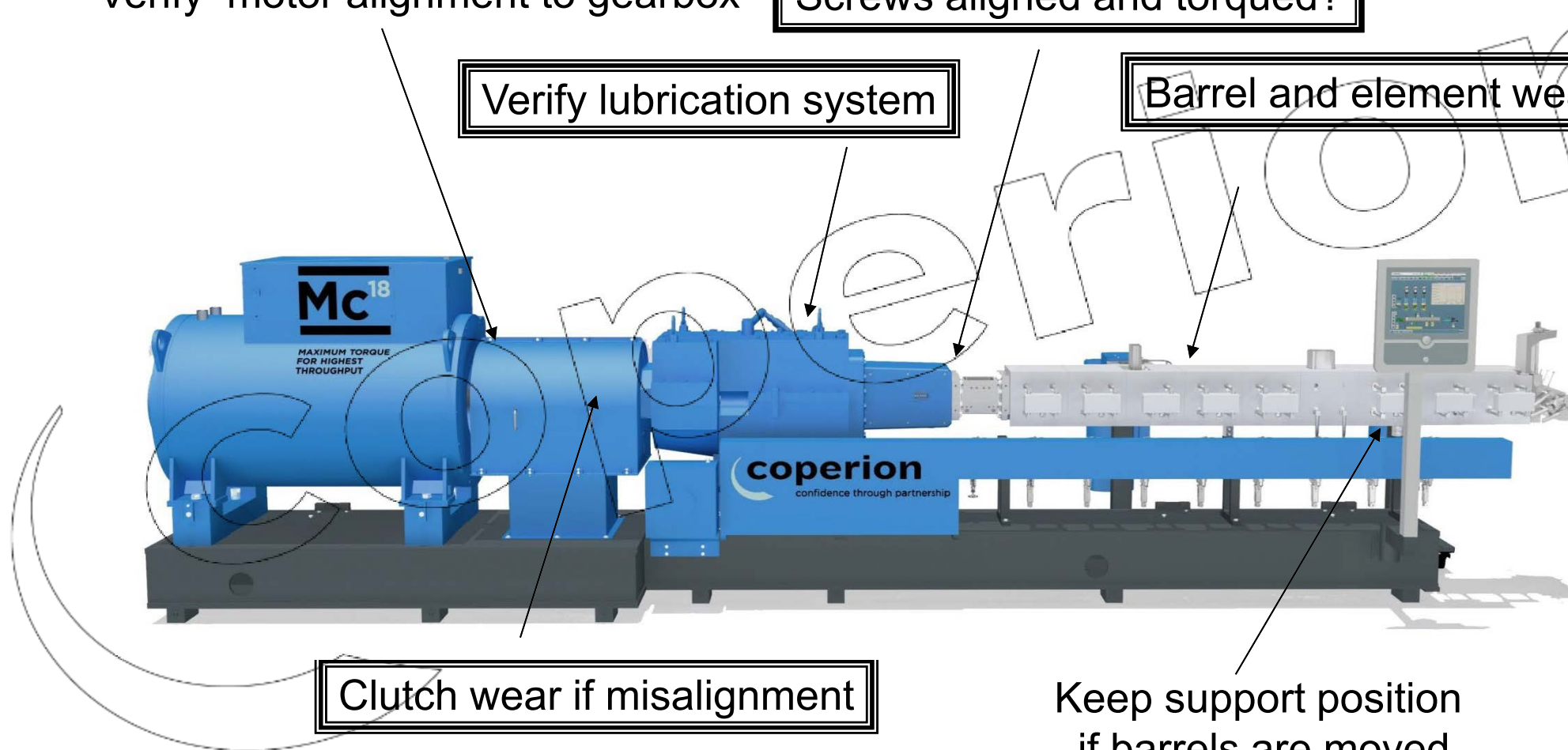
Screws aligned and torqued?

Verify lubrication system

Barrel and element wear

Clutch wear if misalignment

Keep support position
if barrels are moved



Preparations

Before disassembling the screw

Disassembly of the screw

- Loosen the coupling screws in the gear lantern.
- Pull out the screws on the last barrel.

Screw blocked

- Loosen screws tips.
- Mount the disassembly device on the clamping tips.
- **! ATTENTION !**
Left-hand thread
- Pull by chain hoist or forklift.



Cleaning the screw

- Clean screws of remaining material.
- Use a sandblasting device
- Or ask a specialist company to clean the screws.



Secure screw against rotation

- Mount anti-rotation protection at the beginning of the screw to protect the screws against rotation.



Disassembly

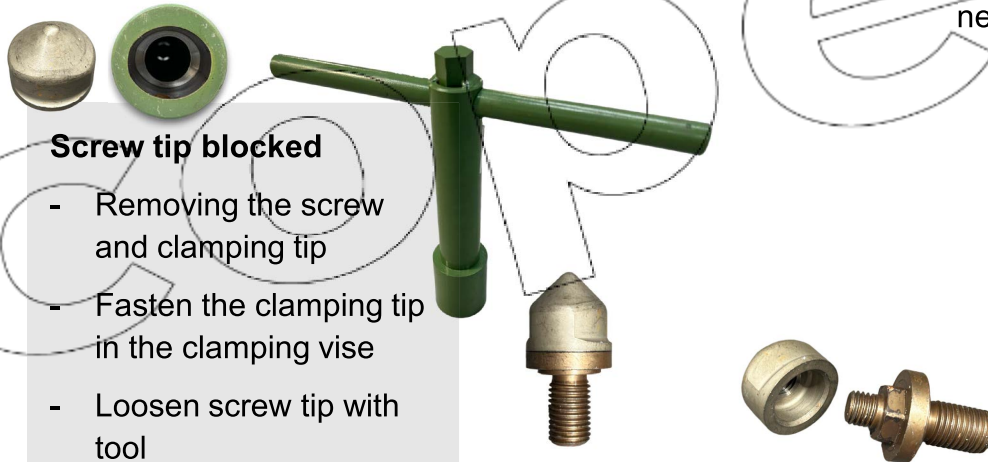
Steps to disassemble the screw elements

Loosen screw tip

- Loosen and remove the screw tip with the tool.
- **! ATTENTION !** -> Left-hand thread
- Tools are supplied by Coperion with every new ZSK.

Screw tip blocked

- Removing the screw and clamping tip
- Fasten the clamping tip in the clamping vise
- Loosen screw tip with tool



Loosen clamping tip

- Loosening of the clamping tip with tool.
- **! ATTENTION !** -> Left-hand thread
- This tools are also supplied by Coperion with every new ZSK.



Disassembly

Steps to disassemble the screw elements

Remove elements

- Pulling off the elements by hand.



Support tools

- Work Gloves
- Burner
- Rubber hammer



Check elements for damage

- Damages are mostly found on the plane surfaces.
- Report damaged elements to the customer.



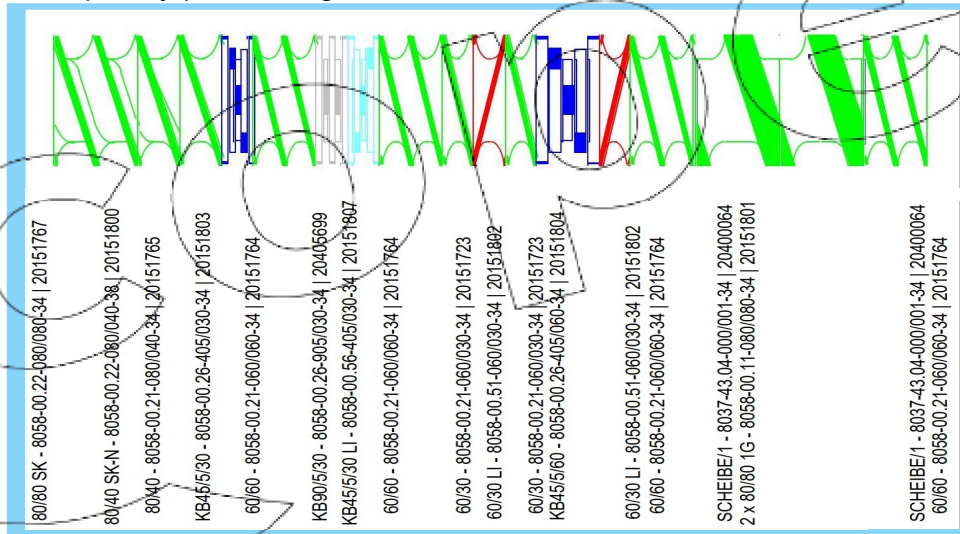
Assembly

Steps to assemble the screw elements

Prepare elements according to the drawing

On the base of the screw configuration control of:

- Correct elements
- Number of elements
- Temporary positioning of the elements

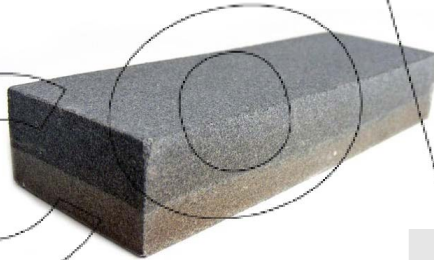


Assembly

Steps to assemble the screw elements

Check elements for damage and flatness

- Damages are mostly found on the plane surfaces.
- Report damaged elements to the customer.
- In case of already used elements, check the flatness of the plane surface with the whetstone.

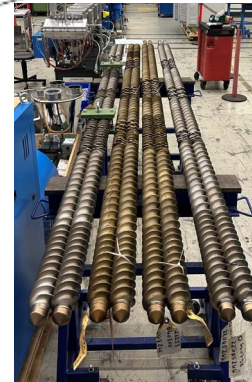


String the elements onto the screw shaft

- For the first element of a screw, pay attention to the position of the toothing-lock.
- Apply further elements to the elements in front of them with an exact fit/ flow.

smooth installation

- Use Molykote P37 on the shaft
- Pro632 LM for food grade applications

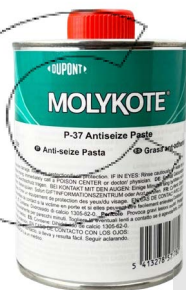


Assembly

Steps to assemble the screw elements

Install the tips

- Screwing in the clamping tips.
- **! ATTENTION !** -> Left-hand thread
- Screwing in the screws tips.
- **! ATTENTION !** -> Left-hand thread
- **! ATTENTION !** -> Different torques

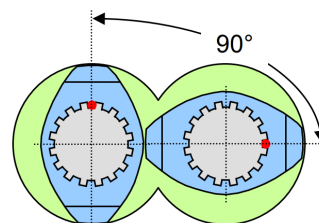


smooth installation

- Use Molykote P37 on the shaft

Offset of 90°

- Look from front
- Left 12 o' clock
- Right 3 o' clock



Roll the screws parallel

- To check the correctness of the installation, both finished screws are placed together with the offset and rolled at the same time.



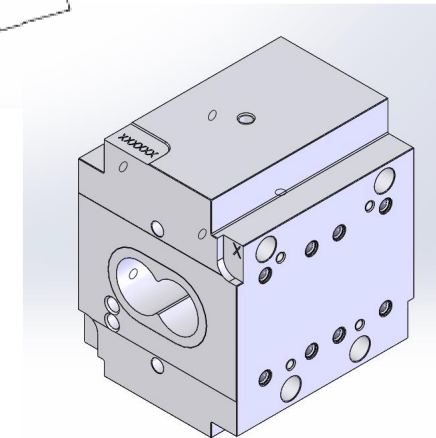
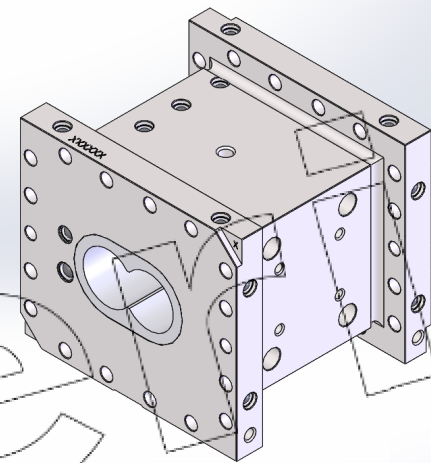
Different types of barrel

What are the different types of barrels?

Flange and tie rod barrels

The difference between the barrels is the assembly.

- The normal barrel is directly connected / screwed together by screws.
- The tie rod barrels are not directly screwed together. These are pulled together by four so-called "tie rods" and thus connected flat.



Disassembly

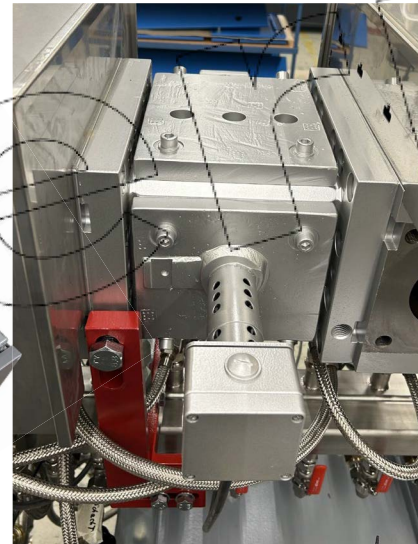
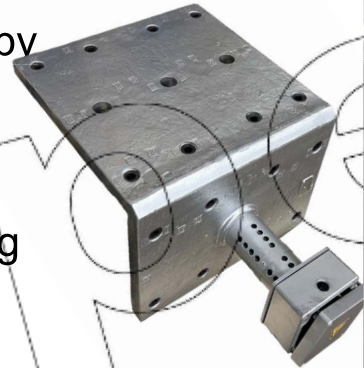
How do I remove the different heaters?

Shell heaters

Shell heaters are fixed to the housing from the outside by screws.

Disassembly sequence:

- Remove electrical wiring
- Remove fixing screws
- Remove heating shell



Disassembly

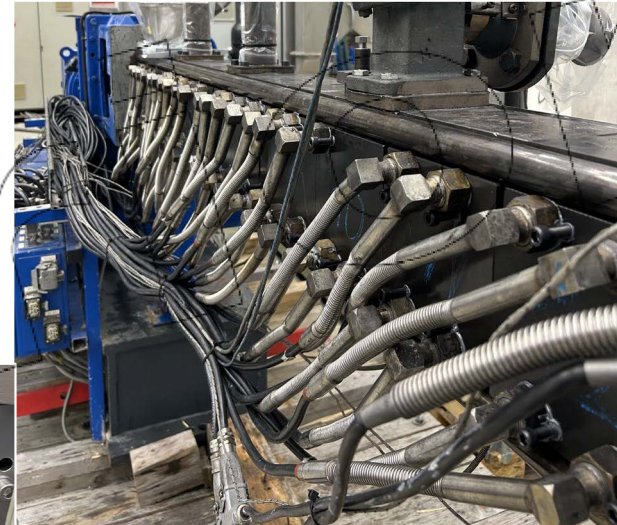
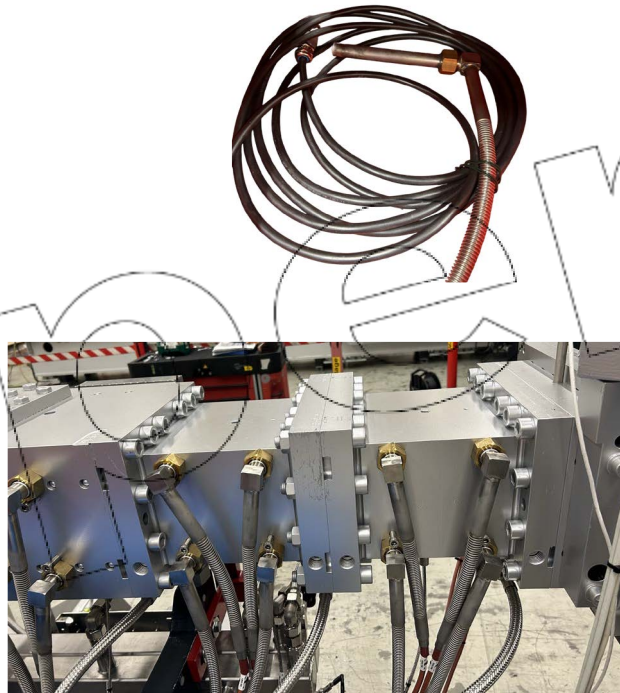
How do I remove the different heaters?

Heating cartridges

Heating cartridges are inserted into the housings and fixed by locking screw.

Disassembly sequence:

- Remove electrical wiring
- Remove locking screw
- Carefully pull the heating cartridge out of the housing.



Disassembly

How do I loosen the barrel?

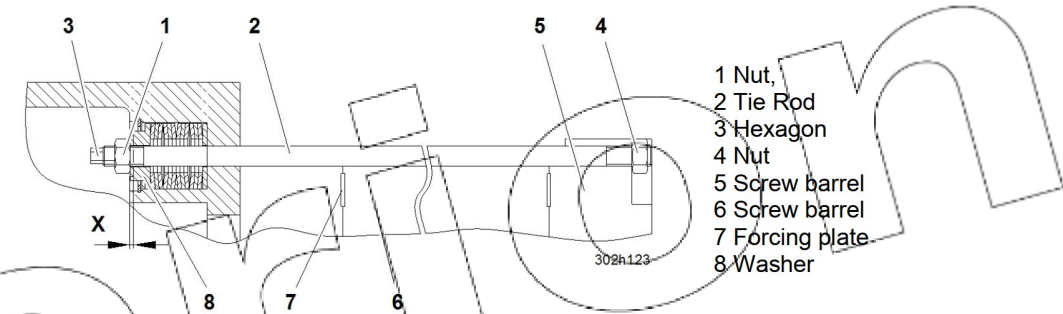
Tie rod barrels

To separate the barrels from each other, the four tie rods must be loosened. Be sure to support the barrel/lower tie rods before loosening.

The tie rods are loosened in the gear lantern (point 1 in the drawing).

After loosening the nuts, the upper two tie rods are able to disassemble.

Now it is possible to pull the barrels apart and take them out upwards.



Disassembly

How do I loosen the barrel?

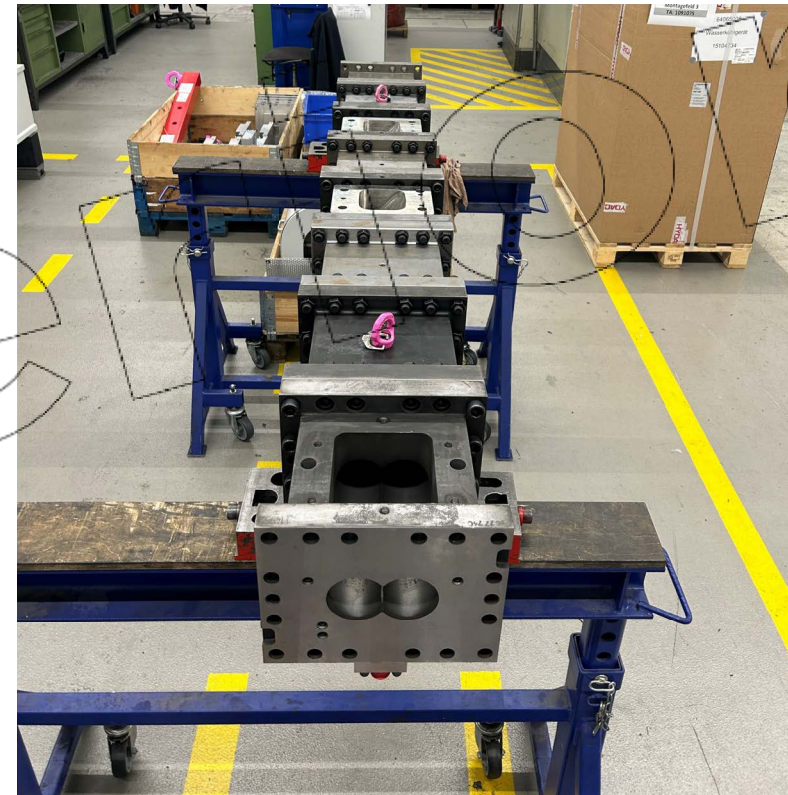
Flange barrels

To separate the barrels from each other, all screws around must be loosened.

To loosen the screws a special wrench is needed.

To remove the barrels, the nearby barrels must be spaced apart, otherwise it is not possible to remove the barrels because they are fixed by the centering bolts.

Be sure to support the barrel before loosening.



Assembly

How do I remove the transport coating?

Transport Coating

The transport coating is applied to prevent the housing from rusting.

To remove this before assembly is best suited brake cleaner.



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Assembly

How do I mount the different barrels?

Barrel installation

The housings must be clean before installation.

If the contact surfaces show marks or unevenness, these should be repaired with a whetstone.

The housings are mounted in the reverse order of disassembly.

The screws should be coated with Molykote P37.



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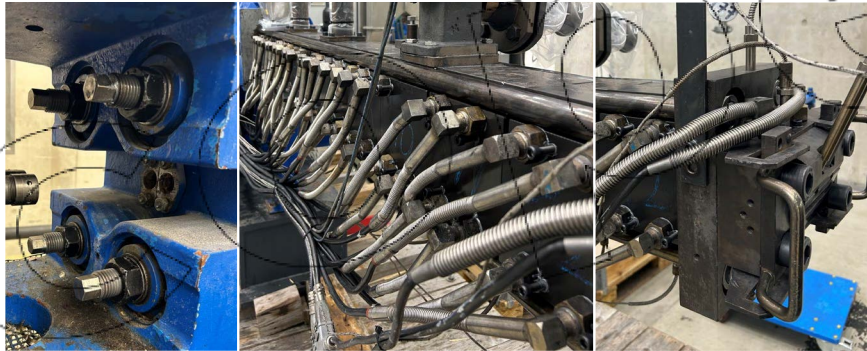
Assembly

How do I tighten the different barrels?

Tie rod barrels

The tie rod barrels are tightened together with the tie rods.

The correct torques can be found in the corresponding lists.



Flange barrels

The normal barrels are tightened with the screws and nuts.

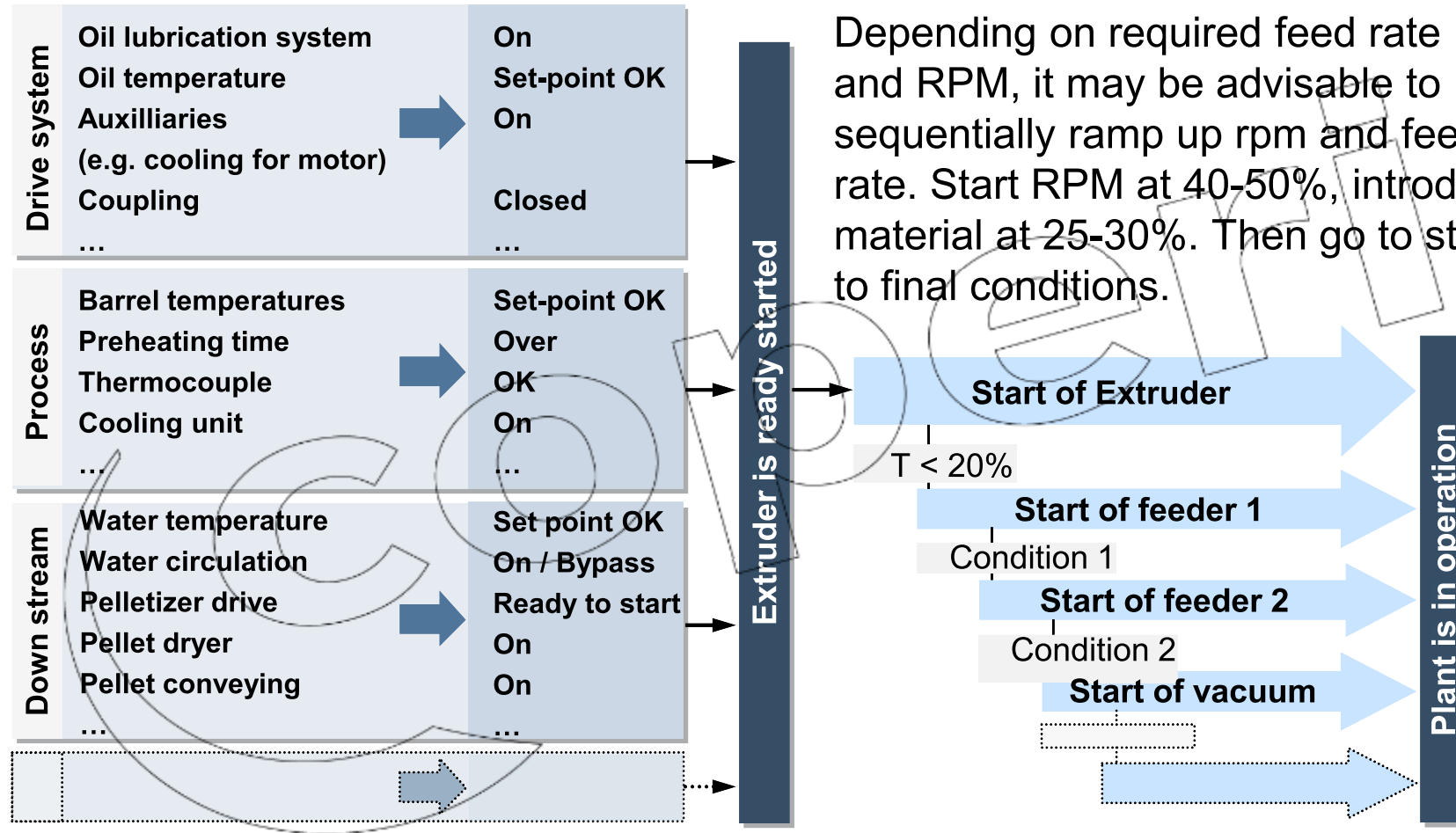
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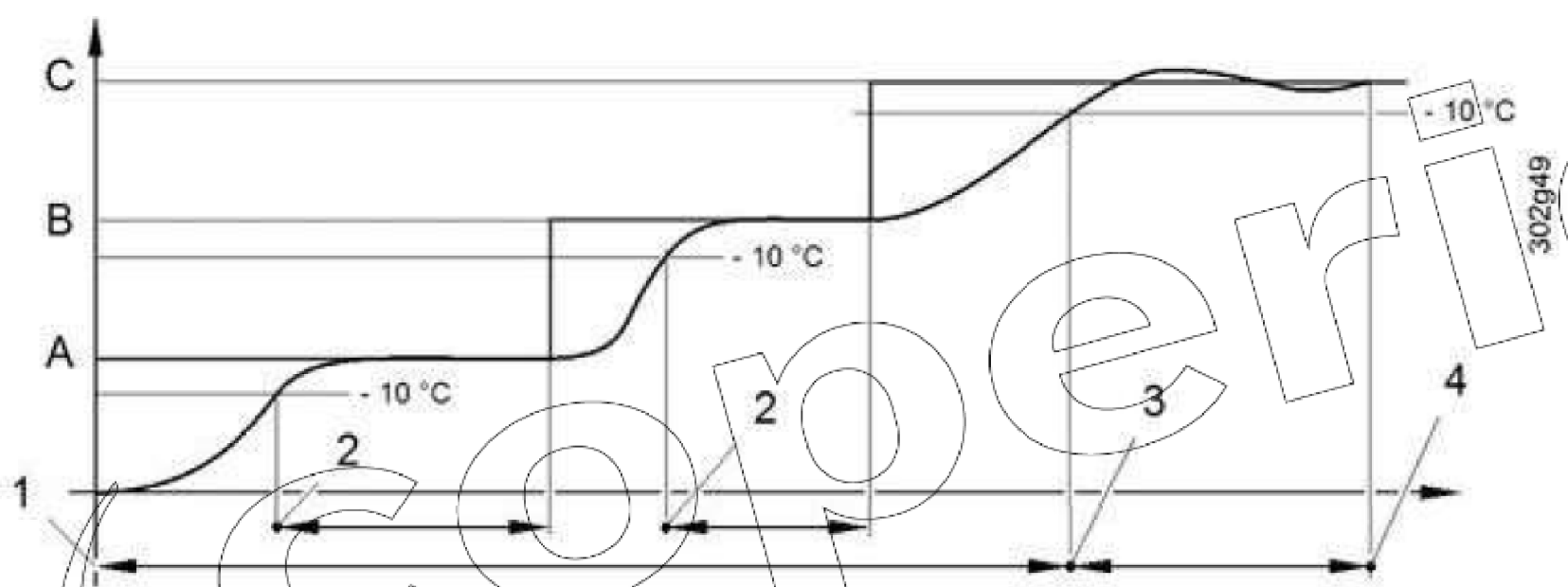
Extruder start up, shutdown, interlocks

Start-up sequence



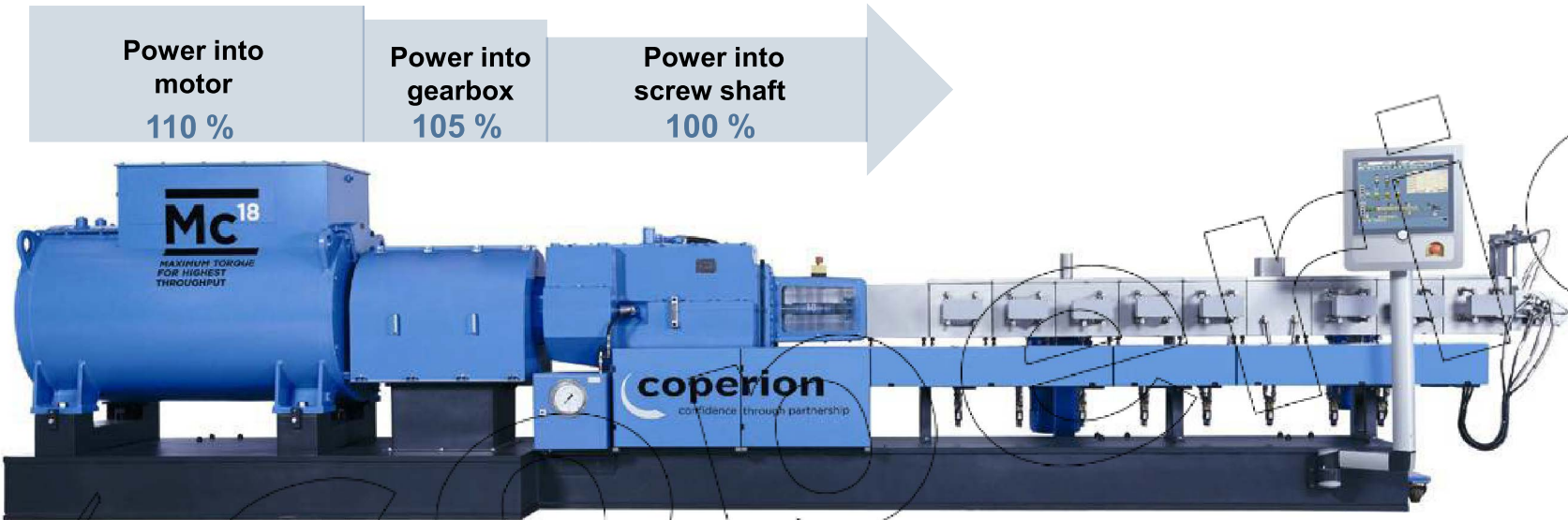
Depending on required feed rate and RPM, it may be advisable to sequentially ramp up rpm and feed rate. Start RPM at 40-50%, introduce material at 25-30%. Then go to steps to final conditions.

Heat-up sequence



Item	Description
1	Start heating time
2	Start wait time
3	Start heating-through time Starts when all setpoint temps reached
4	Extruder ready to start up

High torque operational interlock



	Motor out = Into gear box	Gearbox out = Screw shaft
Continuous operation	< 105 %	< 100%
Alarm	105 %	100 %
Shut off motor	110%	105 %
Open clutch	115 %	110 %

Shutdown Interlock Options

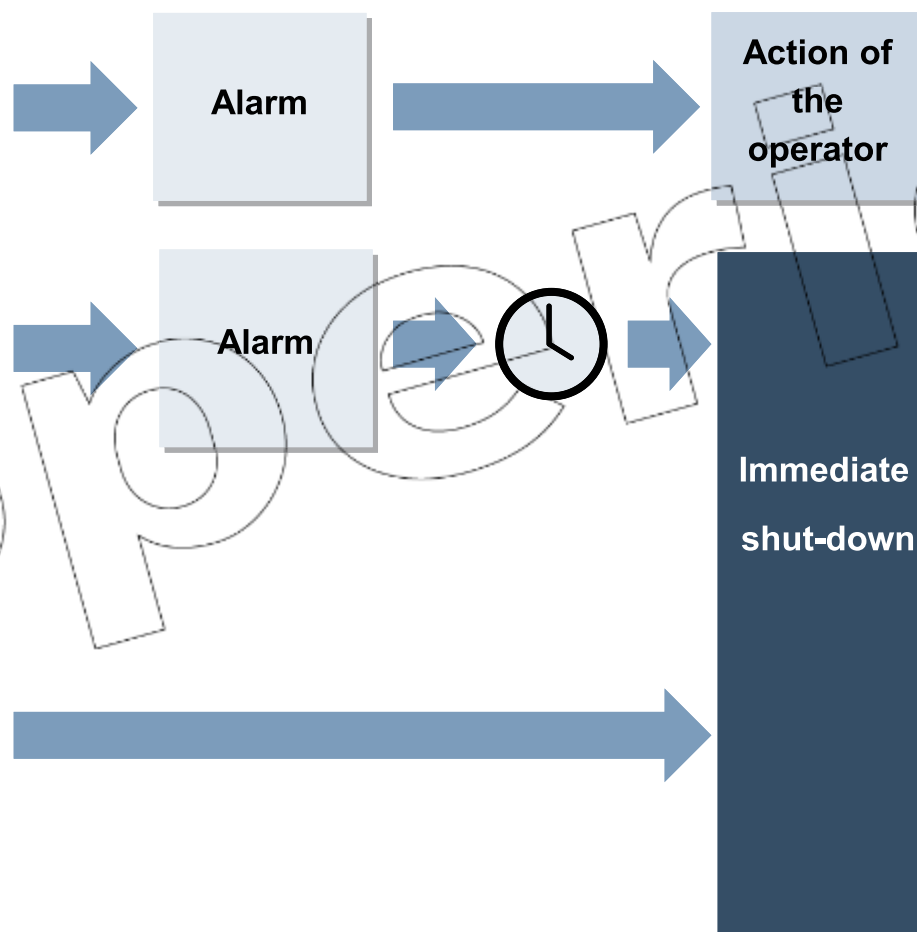
	Standard Shutdown (Machine mechanical limit)	Interlocks based on specific operation
Pressure	~ 2500 psig	1000 psig
High Torque Feeder Shutdown	105 % (or 100 % for 2 minutes	80 % for additive concentrates
High Torque Motor Shutdown	110 %	Usually keep high to clear out stalled machines
Clutch Disengagement	115 %	Motor limit, not gearbox limit ¹
Undertorque	2 minutes <20 % torque	< 5 % torque for very low viscosity material ²

¹ For setups that are motor limited, not gearbox limited

² Gearbox oil & temperature may be change if always at low torque

Operational Interlock Sequence

Defect	Process problems	Barrel temperature too high / low Breakage of thermocouple Problem with feeders Problem with vacuum system ...
	Limits reached	Torque > 105% Pressure at screw tip > P max. Pressure at screen > P max. Pressure at die plate > ΔP max. ...
	Mechanical damages possible	Coupling slips Oilpump for lubrication turns off Problems at pelletizer drive Problems at pellet water system Torque > 110% Pressure at screw tip > P max. Pressure at screen > ΔP max. Pressure at die plate > P max. ...



Things to remember

- Become an “A” student of the machine manual
- Follow the PM schedule listed in the manual
- Perform regular maintenance—do not run-to-failure (RTF)
- Do not change clutch set points
- Use proper lubrication/anti seize—food grade anti seize for food/pharma applications
- Make sure correct materials of construction are used (elements and barrels)
- Use the correct torque specs
- Torque screw tips to torque spec as specified in the manual
- Torque at cold temps unless specifically called out to hot torque for your process/machine
- Document process conditions for acceptable melt quality (SME)
- Have thorough documentation of maintenance records
- Use the correct water quality as per the specs
- Do not start glass feed without first starting the main feed—machine lock up
- “Measure twice, cut once” - consider how your actions are going to affect the machine (mechanical, process, feeders, etc.)

Inspection and reliability

Inspection and reliability

- Routine inspection is important to evaluate the health of the extruder
- It allows maintenance personnel to identify potential wear parts that need to be replaced
- This keeps the extruder running with high reliability
- The goal is to identify worn parts in a “predictive” manner so that contingencies can be made for replacements
- Routine inspection also minimizes the chances of unforeseen failure which can be costly

Inspection and reliability

- PREVENTIVE – Maintenance schedule fixed schedule to repair items with no feedback on actual machine condition
- PREDICTIVE – Maintenance schedule based on feedback on actual machine condition (ex gearbox vibration system)
- CRASH (\$\$\$\$\$\$\$\$\$\$)
 - Downtime expenses
 - Weekend / OT expenses
 - Parts availability
 - Lost production capacity

Identification of key wear areas

[illegible]

Inspection and reliability

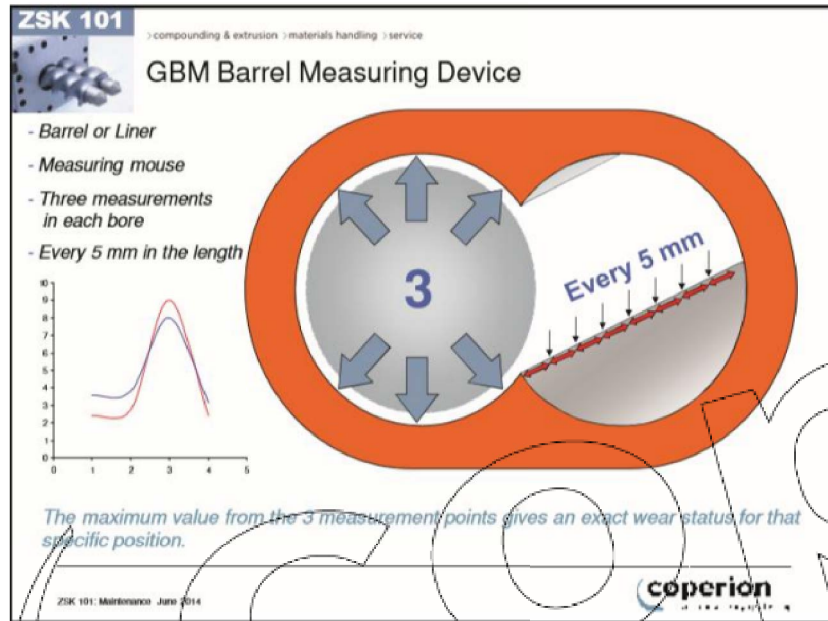


Figure 1: Description of wear measurement

- Bores were measured using a Coperion supplied GBM tool.
- Sensor takes three passes of each bore
 - 90 degrees (L1 or R1)
 - Left of 90 degrees (L2 or R2)
 - Right of 90 degrees (L3 or R3)
- Six lines shown in the graphs below represent each of the different passes made for the barrel bore inspection.
- Bores of the barrel are being viewed from downstream, L1/L2/L3 measurements are of the right bore and vice versa.

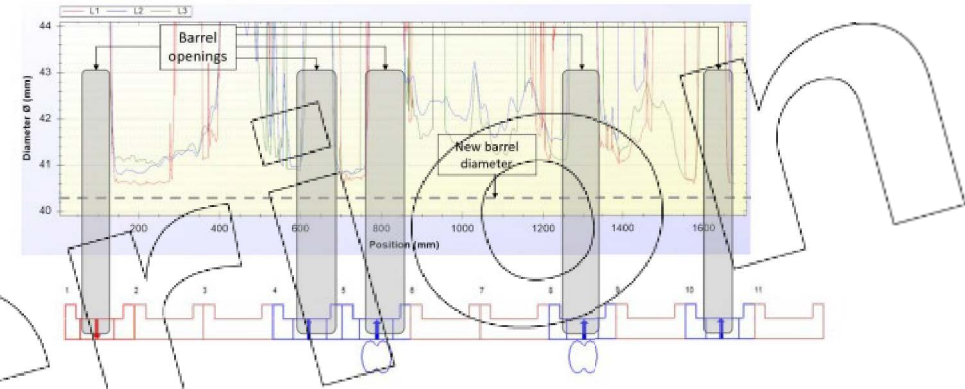


Figure 2: Barrel wear readings for left bore looking downstream

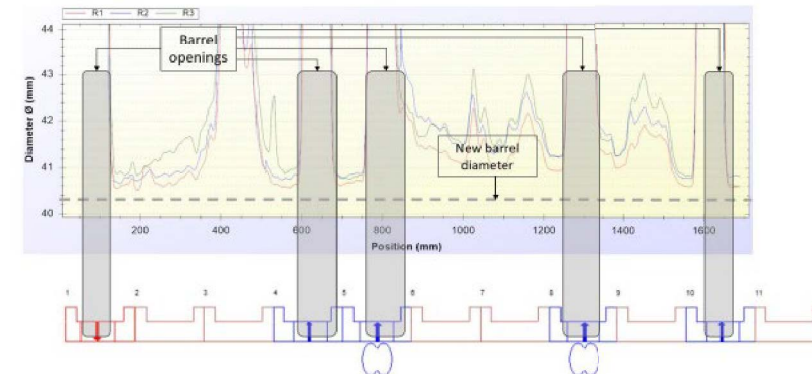
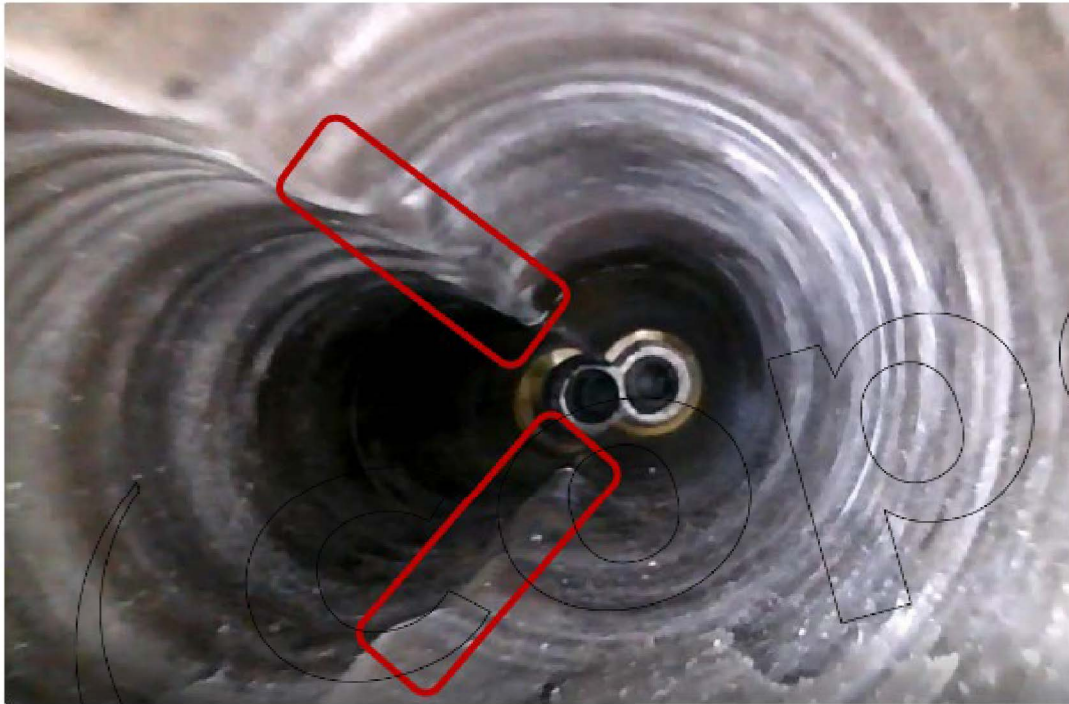


Figure 3: Barrel wear readings for right bore looking downstream

Inspection and reliability



Barrel 3- apex and bore wear



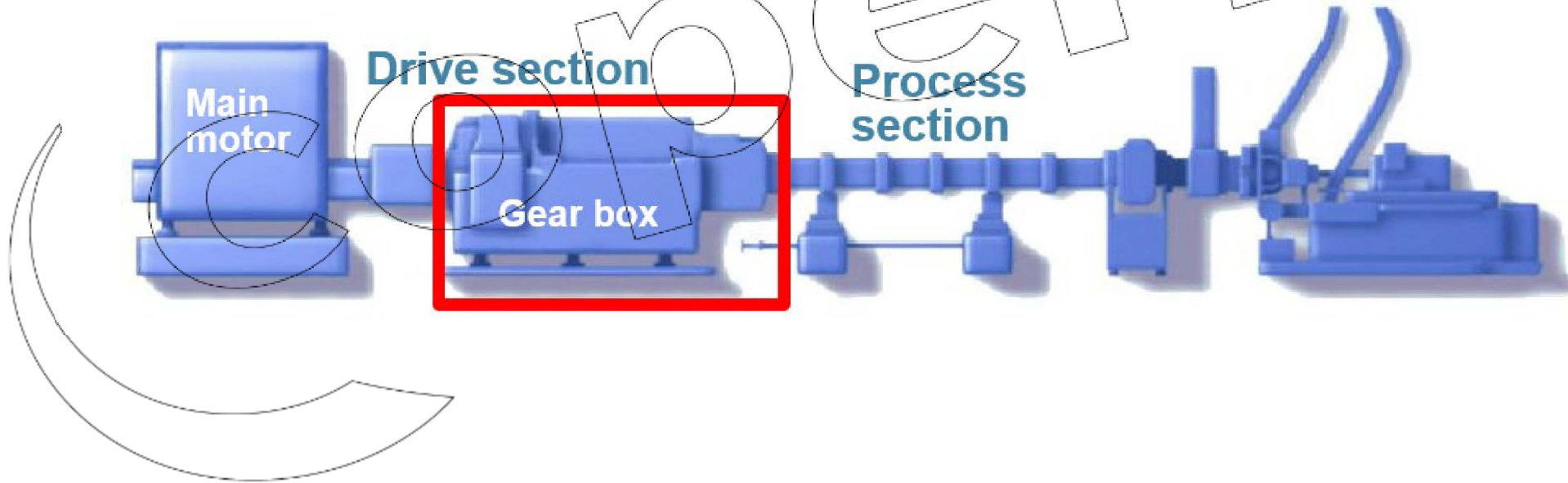
Barrel 5- bottom apex wear

Inspection and reliability

Gearbox maintenance

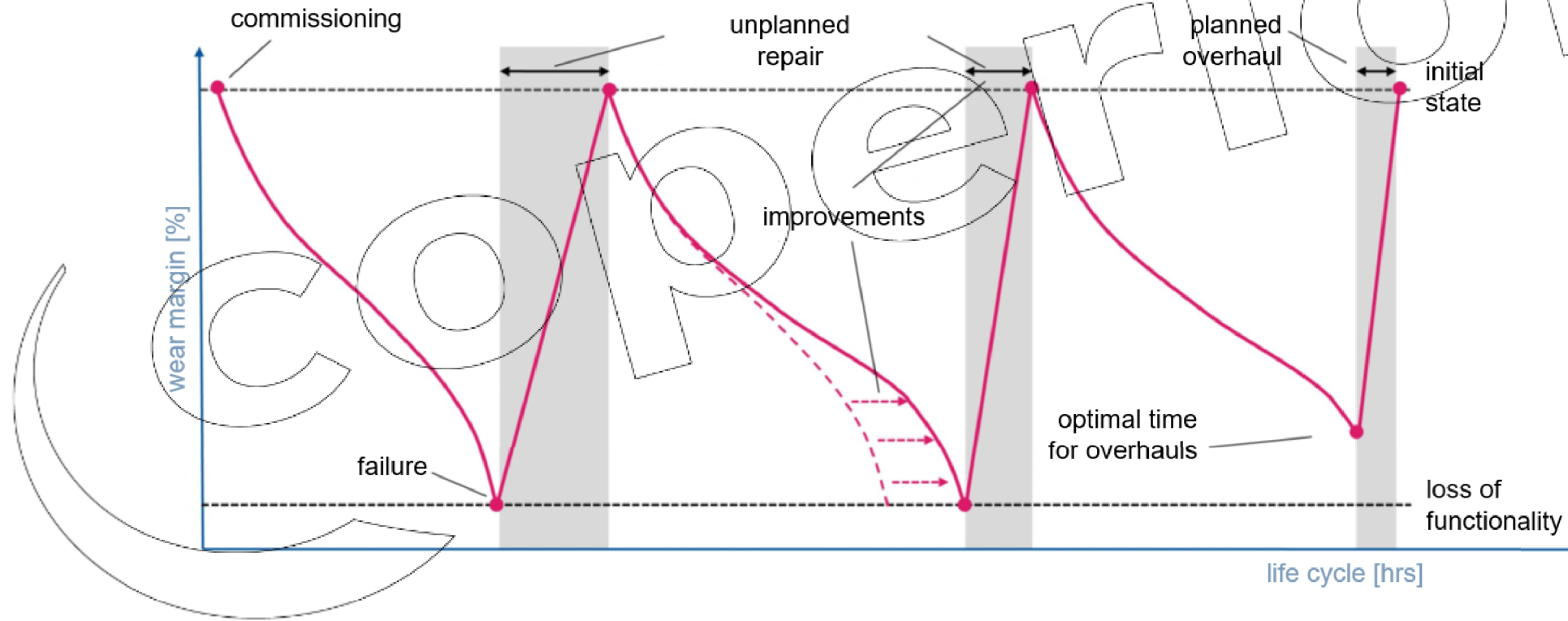
The GEARBOX is approx 15 – 25% of the value for the extruder train and the **most valuable single component** !

Approx 70%-80% of extruder train service work is generated out of gearbox overhauls.



Inspection and reliability

The operator must ensure compliance with the specified intervals.
If the specified intervals for maintenance and servicing work are not met, the gearbox will be damaged.



Inspection and reliability

The intervals specified in the maintenance schedule are largely dependent on the operating conditions of the gearbox.

For this reason, only average intervals can be specified here considering the following:

- Daily operating time 24 h
- Duty cycle "ED" 100 %
- Specified oil temperature and cleanliness
- Rated drive speed
- Nominal torque

Inspection and reliability

The bearing service life defines overhaul interval

Machine size	Rated minimum bearing service life
ZSK018 - 026	10.000 hrs
ZSK026 - 177	20.000 hrs
ZSK177 - 420	40.000 hrs

reference values only

Inspection and reliability

New gearbox types in service

Machine size	Gearbox type	Rated bearing service life (operating hours)	Recommended maintenance of the gearbox (after the bearing service life has expired)
ZSK040 MCC	33 E 510	> 20.000 hrs*	Replacement of all bearings, seals, filter, oil (if necessary), visual inspection of internals, MPI of shafts and gears, check of instrumentation, clean exterior
ZSK058 MC18	48 E 2000	> 20.000 hrs*	
ZSK070 MC18	58 E 3500	> 20.000 hrs*	
ZSK092 MC18	76 E 7900	> 20.000 hrs**	

* at screw speed 1200 rpm / **at screw speed 1000 rpm

Maintenance schedule

Intervals

400 operating hours
after commissioning (new installation or longer
standstill)

Every **2000** operating hours

Every **3 months**

Measures

Check the water content of the oil.
Change the oil (or depending on the oil sample
result) Check fastening bolts for tightness

Oil analysis

Clean the air filter

Replace desiccant breather if necessary

Check lube oil filter and replace if necessary

Measure the vibrations of the roller bearings

Measure the bearing temperature of the roller

bearings Check the sight glass

Check overrunning clutch

Check switch-off function of the speed monitoring

Drive (if available)

Maintenance schedule

Intervals	Measures
Every 12 months	- Clean gearbox housing - Clean lantern - Check roller bearings - Check the gearwheel bearing - Check the condition of the tooth flanks - Check the tooth flank condition of the running toothing - Check hose lines - Check internal condition
Every 10.000 operating hours , at least every 2 years	- Change the oil - Check the condition of the water/oil cooler (at the same time as the oil change)
Every 2 years	- Carry out gearbox inspection - Check fastening screws for tightness

Maintenance schedule

Intervals

Every **6 years**

(after the printed manufacture date)

After reaching the bearing service life

Measures

Change hose lines

Full overhaul:

Replace of all bearings, seals, filters and oil (if necessary)

Visual inspection and dimensional check of internals

MPI of shafts and gears

Check of instrumentation

Clean exterior

Coperion Aftermarket

Performance materials

The Coperion Network



Facts and Figures



20000

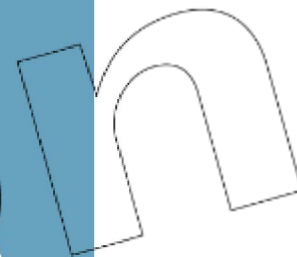
FEEDING SYSTEMS
INSTALLED

Facts and Figures



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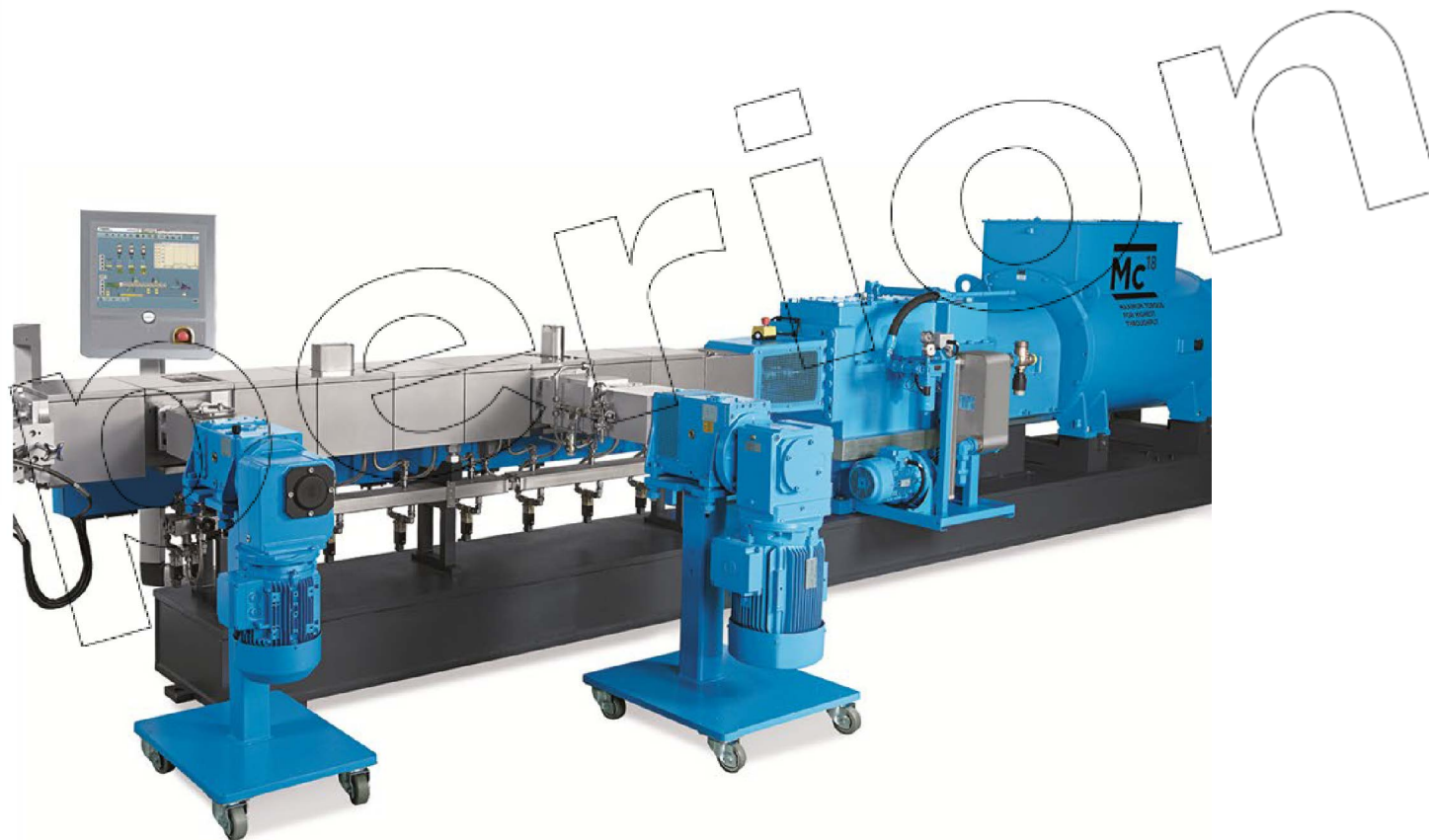
BULK MATERIALS HANDLING
PLANTS INSTALLED



Facts and Figures

12000

COMPOUNDING SYSTEMS INSTALLED

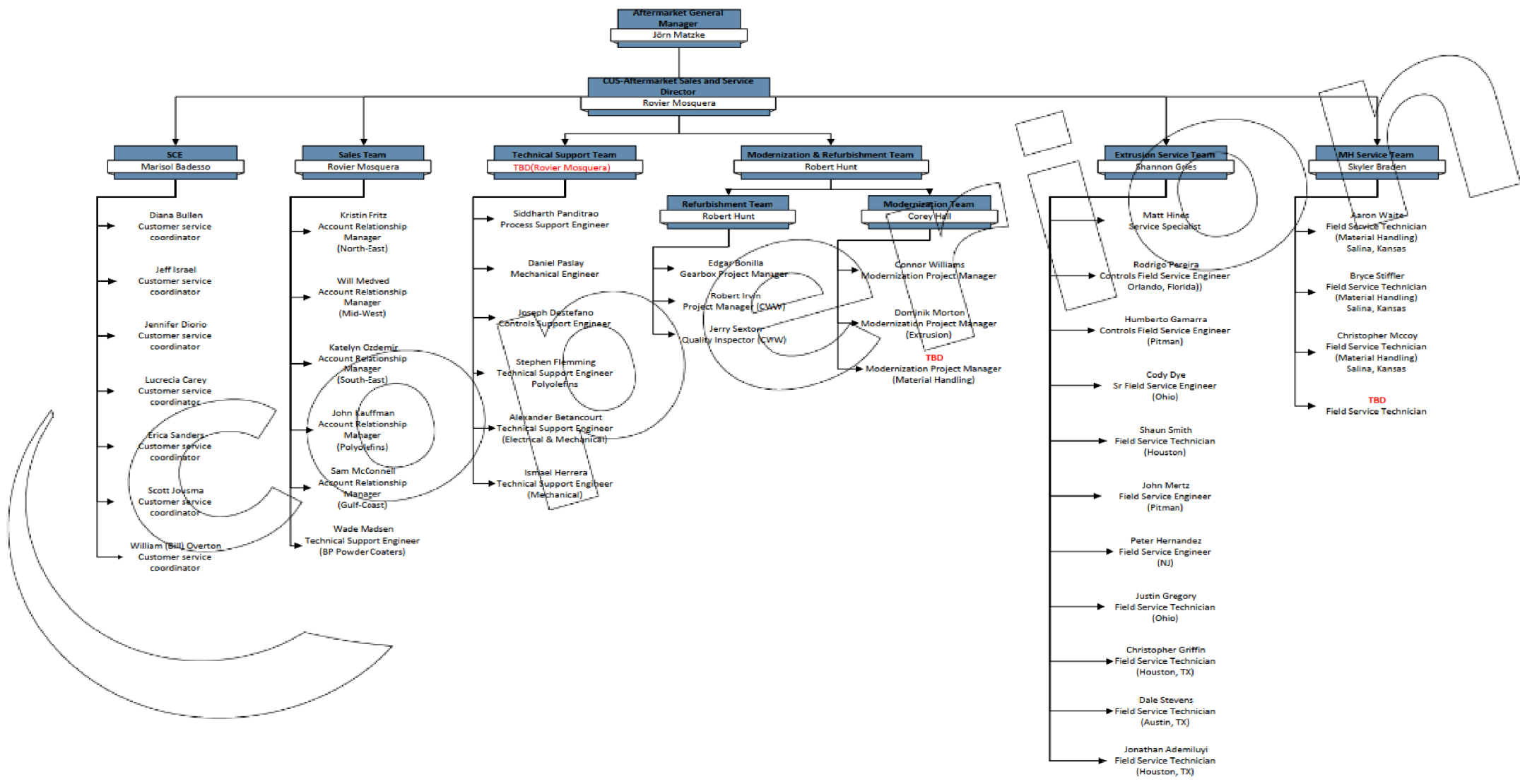


Aftermarket Performance Materials



CUS-APM Org Chart

Wednesday, October 1, 2025



Our Aftermarket Service Philosophy



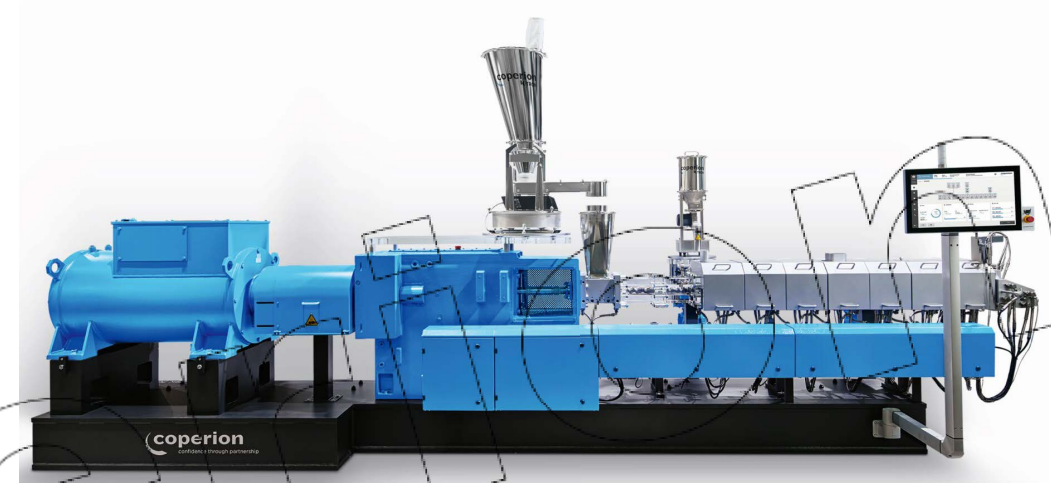
- Customer-centric approach
- Proactive and predictive maintenance
- Customized solutions tailored to your operations
- Long-term partnership for continuous improvement



Core Aftermarket Services Overview



- Maintenance & Inspection
- Spare Parts & Components
- Equipment Refurbishment & Modernization
- Field Service & Support
- Training & Technical Consultation
- Digital Monitoring & Condition-Based Maintenance



- ### COPERION SCREW ELEMENT WEAR REPORT

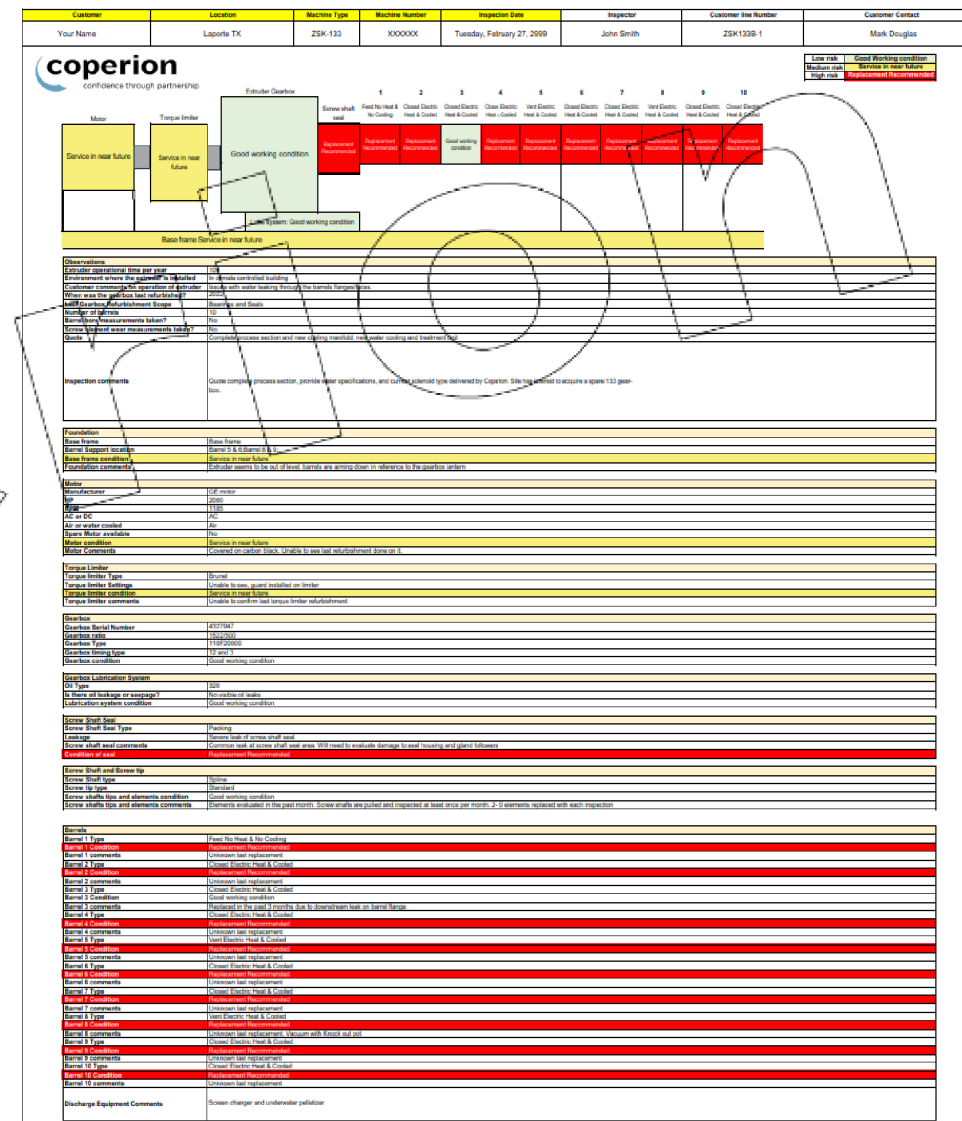
Customer	
Customer name	Client Name
Installation date	Installation Date
Inspector name	Inspector Name
QR of Project Number	QR of Project Number
Machine number	Machine Number
Machine type	Machine Type
Machine size	Machine Size
Material	Material
Screw pitch length (mm)	Screw Pitch Length (mm)
Remarks	Remarks

This is screw element wear found in the population from regular evaluation of different parts of construction to reduce wear rate in the location

Customer	QR Number	Gearbox Type	Serial Number	Report	Inspector Date	Inspector
				Inspection	October 21, 2024	Steven King

This is screw element wear found in the population from regular evaluation of different parts of construction to reduce wear rate in the location

Customer	QR Number	Gearbox Type	Serial Number	Report	Inspector Date	Inspector
				Inspection	October 21, 2024	Steven King



Spare Parts & Components

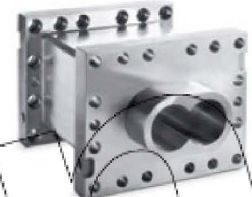
- Fast delivery and availability
- Critical wear parts: screws, barrels, seals, bearings
- Upgrades and improved component options
- Stock management and logistics support



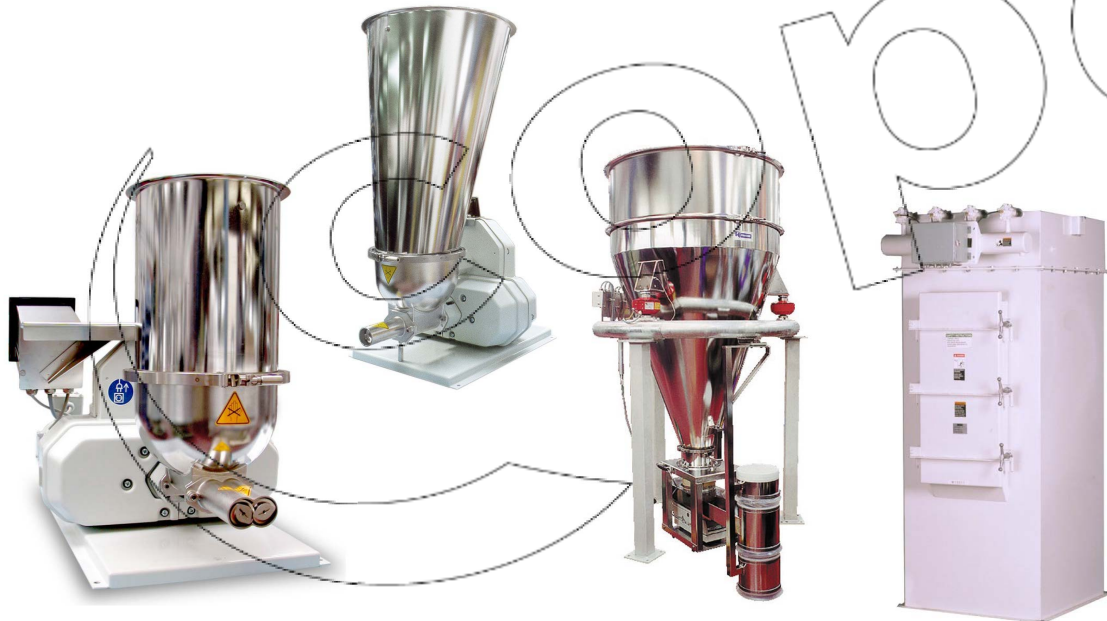
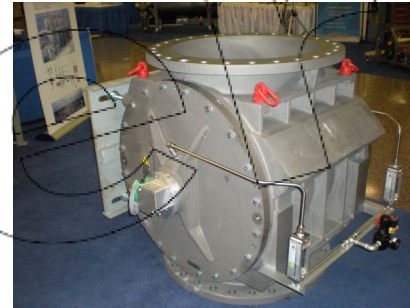
→ Wear and corrosion resistant screw elements



→ Direct coated barrel



→ Barrel with oval liner



Equipment Refurbishment & Modernization

- Complete refurbishment to restore equipment to near-new condition
- Upgrading control systems for improved accuracy and efficiency
- Retrofitting existing equipment with latest technology
- Cost-effective alternative to new equipment purchase
- Case studies of successful modernization projects



Digital Solutions & Condition Monitoring

- Remote monitoring and diagnostics
- Data analytics for predictive maintenance
- Equipment health dashboards
- Software updates and upgrades
- Integration with customer systems

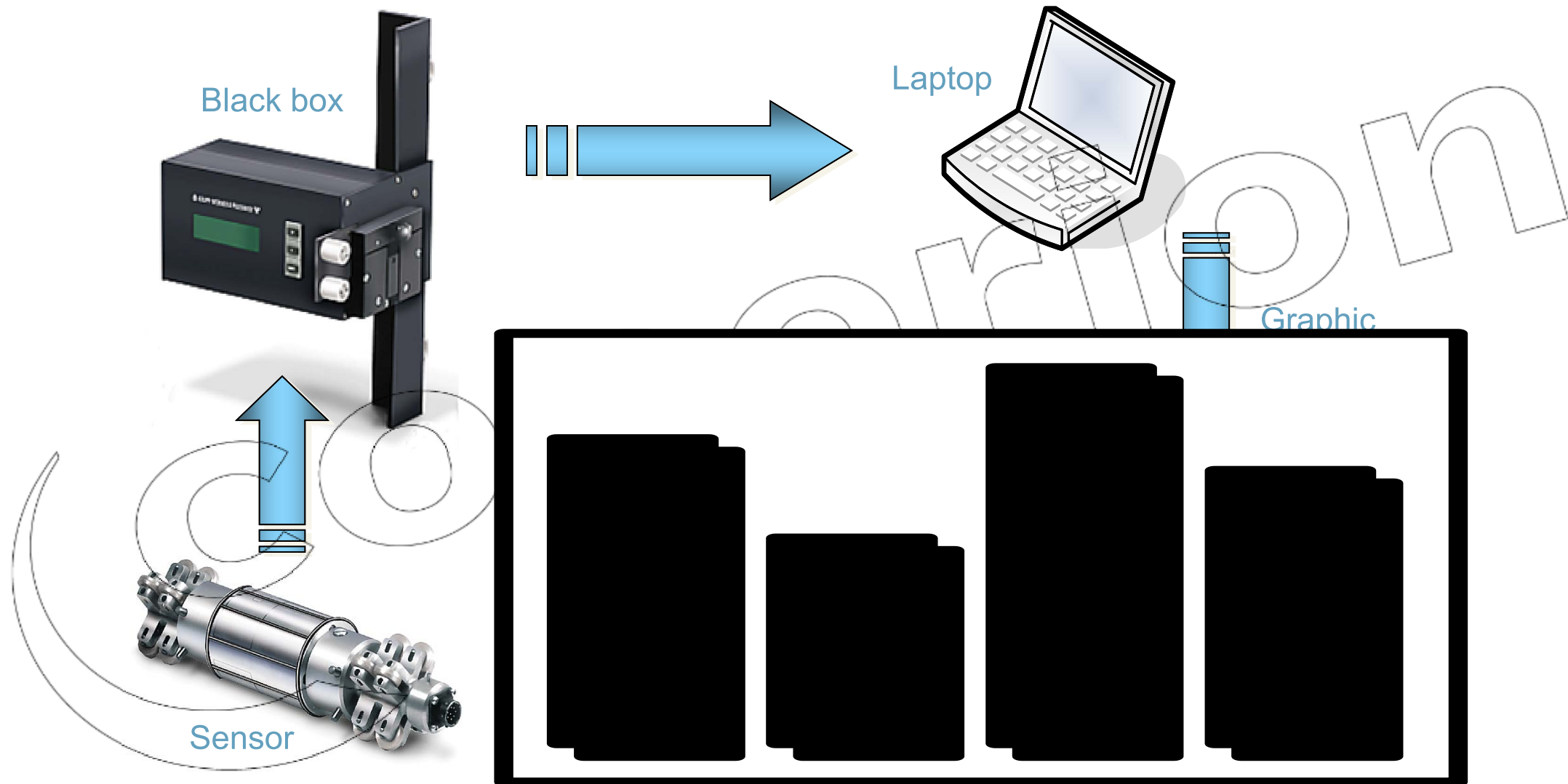


Field Service, Technical Consultation & Training

- Onsite Field Service Support
- Operator and maintenance staff training programs
- Process optimization consulting
- Equipment troubleshooting and best practices
- Customized training modules



Data Transfer to the Laptop



Lifecycle Support & Customer Partnership

- Long-term service agreements
- Continuous improvement programs
- Reliability optimization and plans
- Spare part forecasting



Inspection Checklist for Twin Screw Extruders

Customer		Coperion Cooperative Service Certification	
Street		Machine Type	Operating hrs
City		Machine #	Line No.
Serial	Zip Code	Machine Project No.	Weeks No.
Contact		Coupling Type Main Drive	A/W Power
Phone #	E-mail	Start of Work	End of Work
Requested by:			

Product Feeder Arrangement for ZSK Machine

Vibrating chute	☐	Feed Screw	☐	Weight belt feeder	☐	In combination with stuffing screw	☐
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Extruder Assembly

Verification of machine level	Width Spec.	☐	Out of Spec.***	☐
Comments ***:				

Extruder Motor

Manufacturer	HP	RPM	Type: AC	☐	DC	☐
Comments ***:						

Safety Coupling between Main Drive & Gearbox

Condition of Coupling	Good	☐	Poor ***	☐		
Comments ***						
Check of coupling alignment?	Yes	☐	No	☐		
Measurement: (Deviation)	Axial	mm/inch	Radial	mm/inch		
Alignment checked by:	Laser	☐	Gauge Indicators	☐	Straight Edge	☐
Verify correct disengagement torque?	Yes	☐	No	☐	Value	lbs/ft
Photographs attached?	Yes	☐	No	☐	Number of photographs:	

Adjustments for Main Drive Coupling

Adjustment to Desch coupling:	air pressure setting	bar				
Mechanical Couplings: Type	Autogard	☐	Brunei	☐	Other:	
Coupling Adjustment	mm/inch					
Photographs attached?	Yes	☐	No	☐	Number of photographs:	

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Contact

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Thank you for your attention.

You're very welcome to follow us.

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