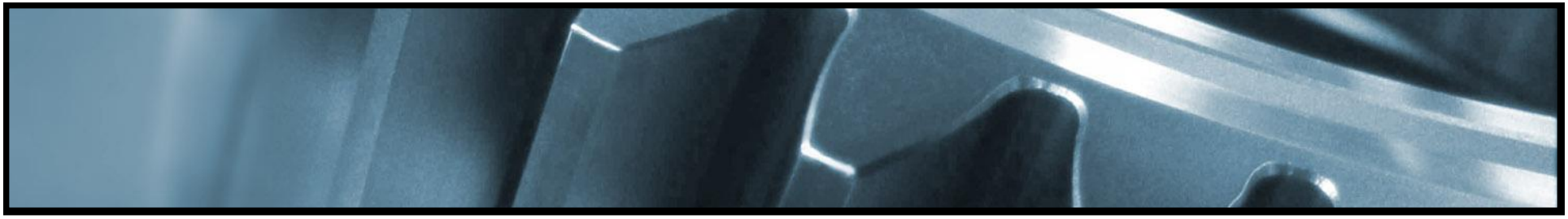

Paper
9.6.2008

Matti Sivonen

moventas

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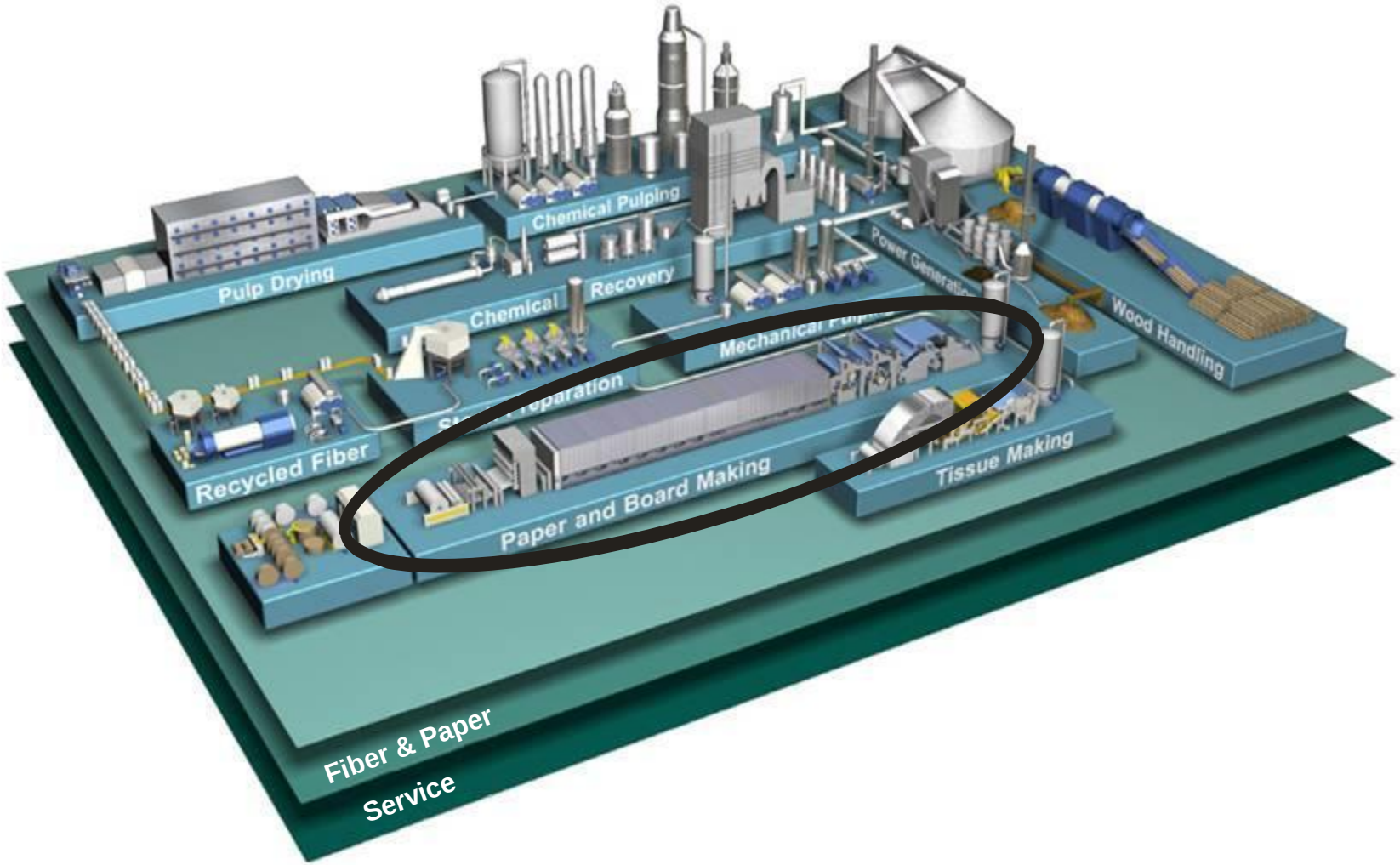
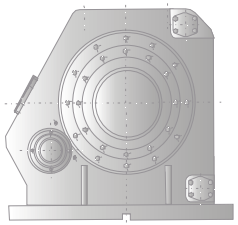
Paper Machine Drives



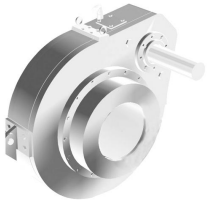
30-150 drive points in a paper machine...

SR-700-2
Couch suction roll



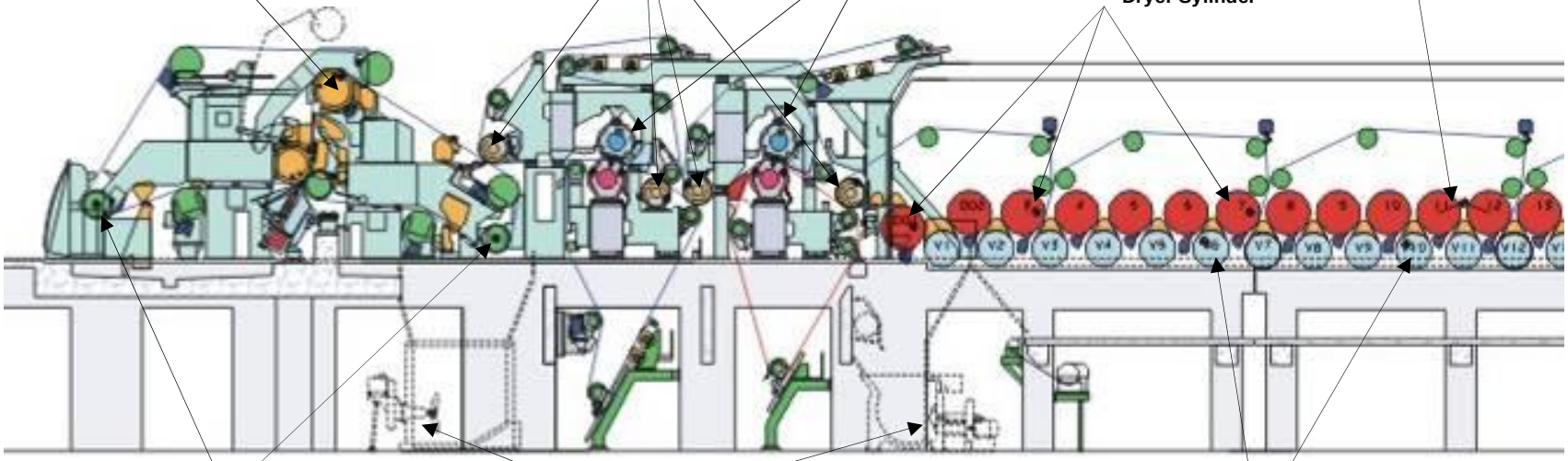
MSR1G-530
Pick-Up suction roll
Transfer suction rolls
Felt suction roll

2x1CBPG-900
Long Nip Roll



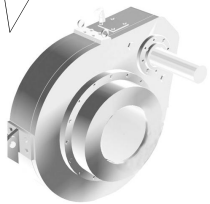
D1PHT420C
Dryer Sylinder

DRG 2100H
Dryer Sylinders



D1PSF60
Turning Rolls

D1PSF60
Pulper



D1PHT420V
Vacuum roll

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…designed for the special needs

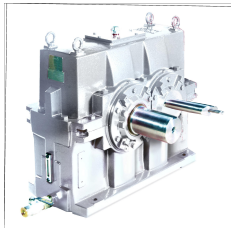
D1PSF60
CHG136C1-DB
Top thermo roll

D1PSF50
Sym-Sizer

DRG 2100H
Dryer sylinders

ZSTG-11650 Deflection-compensated roll

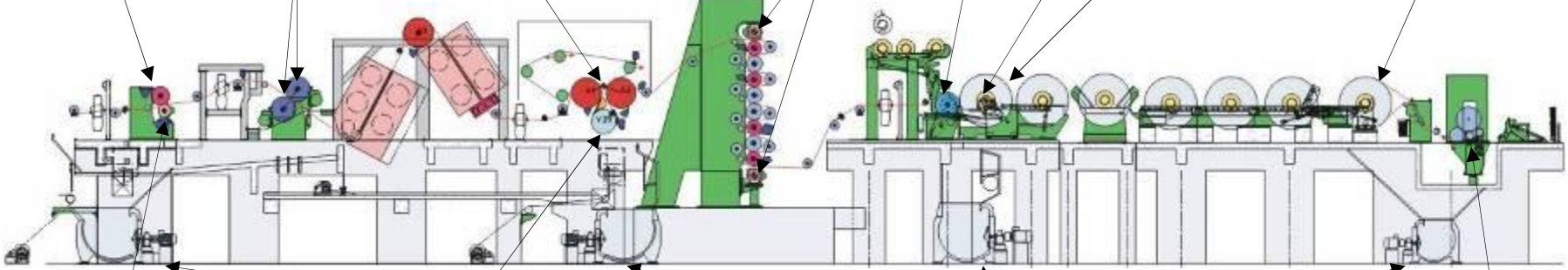
D1PSF60
Reel drum



S1G-355-ORC-T1.0
Secondary center drive

S1G-280-ORS-T1.0
Primary center drive

CHG156M1.0-DBT
Unwind driver



ZSCG-10590
Deflection-compensated roll

2X2GL-900-M2.1
Drives for sitter winder

D1PHT420V
Vacuum roll

D1PSF60
Pulper

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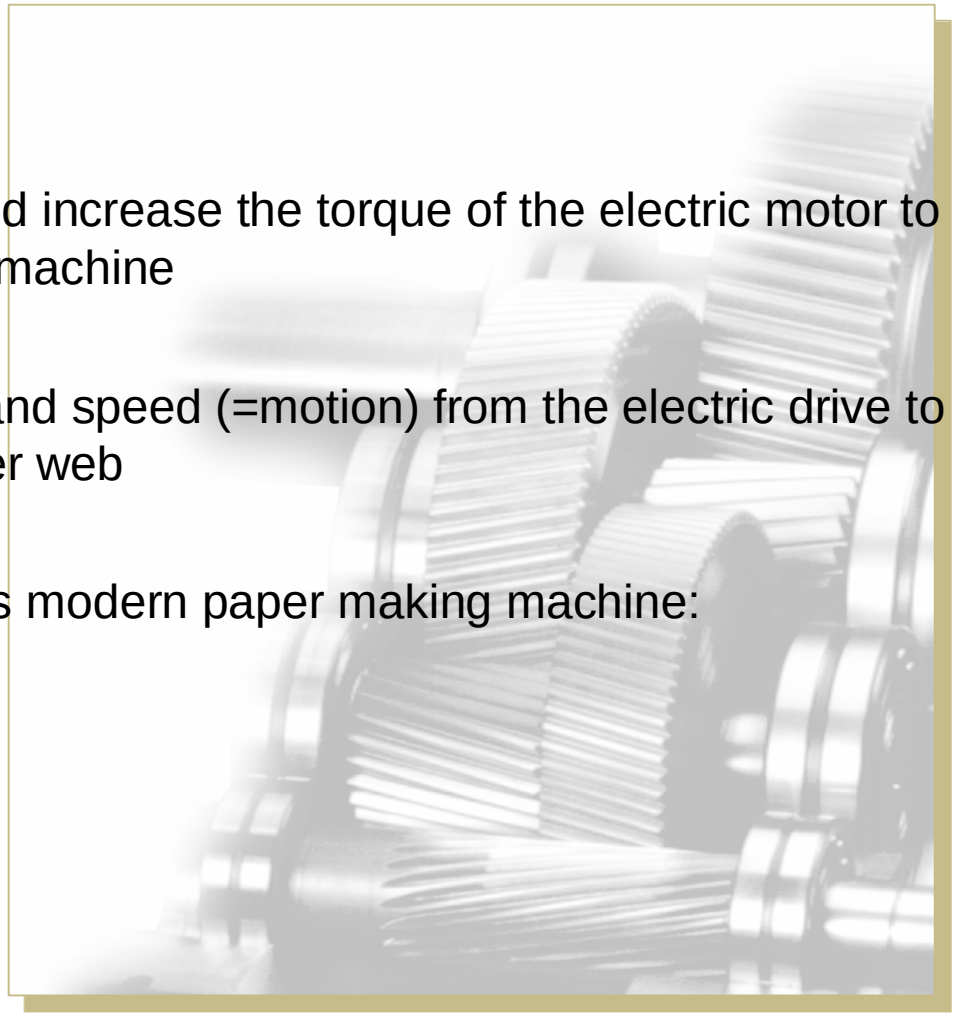
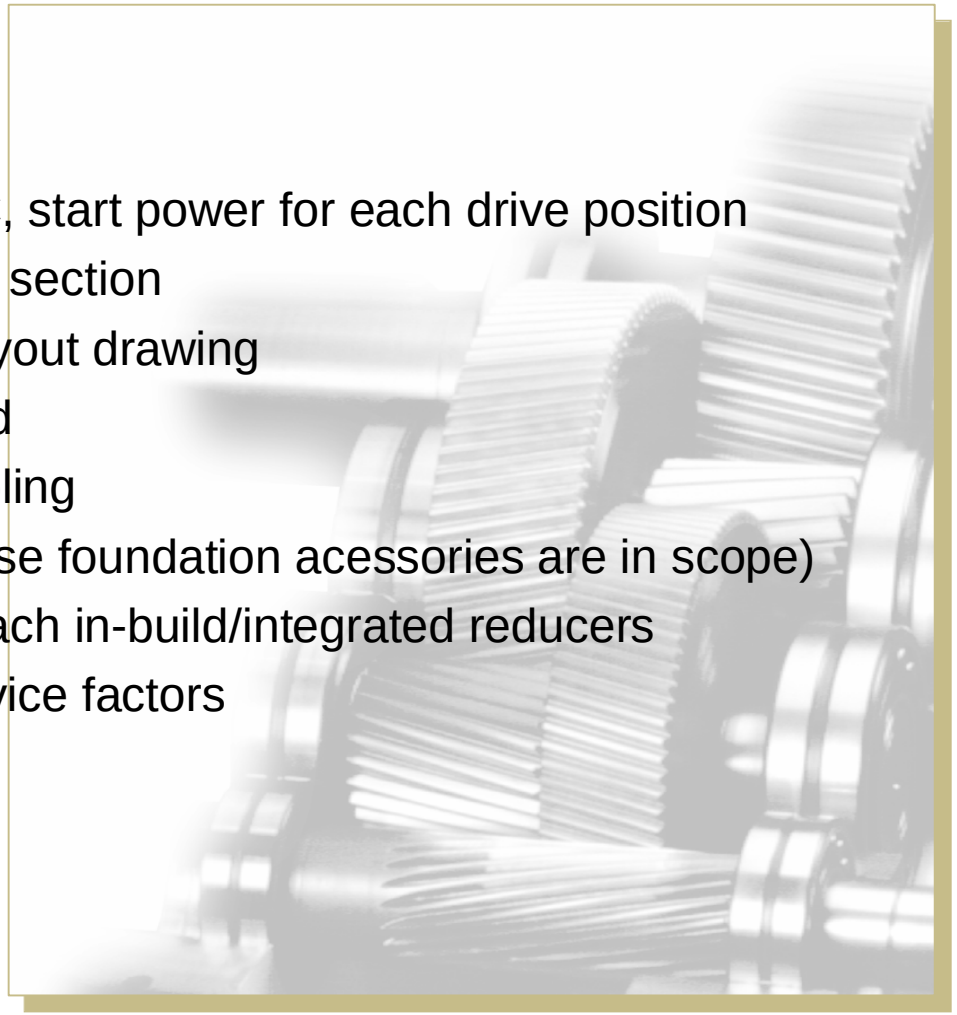
Mechanical Drive Requirements



- Reduce the rotation speed and increase the torque of the electric motor to meet the needs of the driven machine
- Transfer the required power and speed (=motion) from the electric drive to the roll shell / wire / felt / paper web
- Drive requirements for today's modern paper making machine:
  - Reliability
  - Low vibration levels
    - stability
    - low noise
    - excellent runnability
  - Easy maintenance

Required input information for quotation

- Power calculation: NRL, RDC, start power for each drive position
- Web speed for each machine section
- Roll diameters and the PM layout drawing
- Required electric motor speed
- Method of lubrication and cooling
- Foundation information (in case foundation acessories are in scope)
- Internal reduction ratios for each in-build/integrated reducers
- Customer requirement of service factors
- Movable/ stationary rolls



Layout design of PM drive

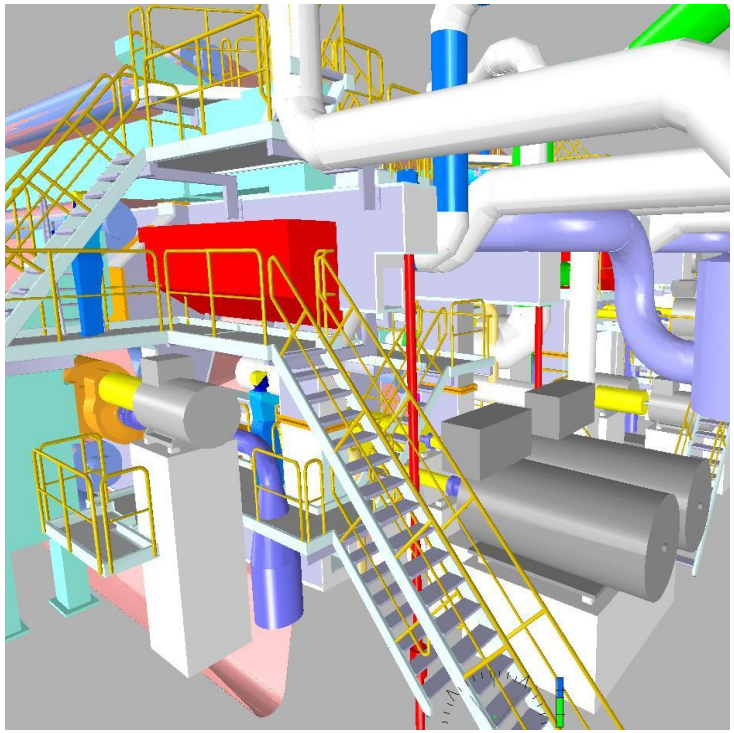
Project management: new machines and rebuilds

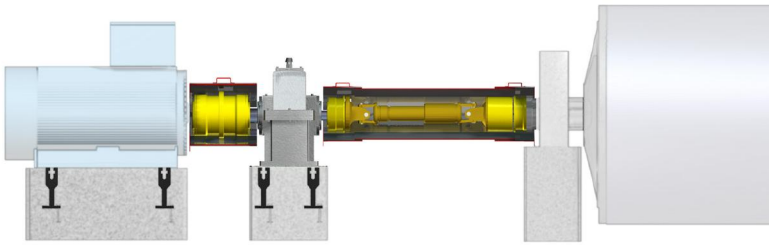
1. Location, foundation and installation drawings
2. Selection of transmission ratios of gear units
3. Dynamic reviews, e.g. strength and torsional vibration calculations
4. Customer specific documentation

Dimensioning and selection of components

1. Gear units according to requirements of each drive point
2. Universal shafts
3. Couplings, e.g. gear and steel disc couplings
4. Jack shafts
5. Foundations, e.g. anchor studs, steel foundations and foundation bolts
6. Safety guards for couplings and shafts

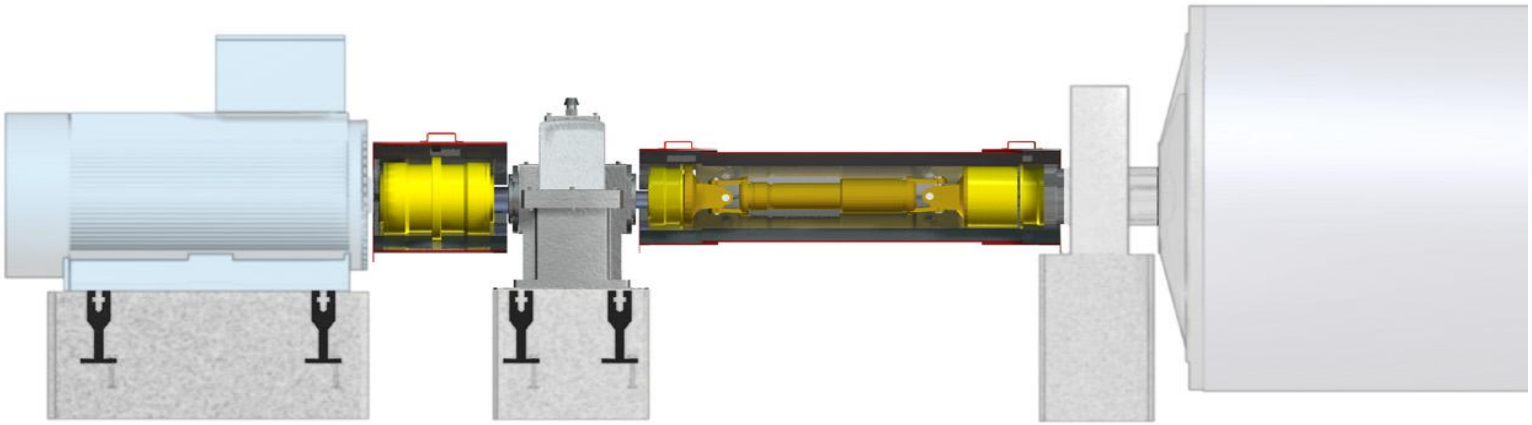
3D modelling as per customer's needs





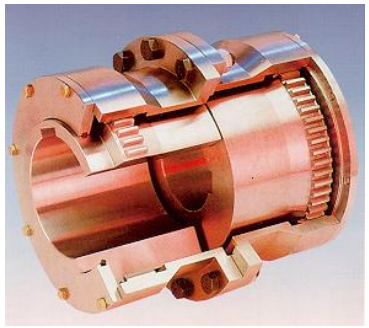
Complete Mechanical Drive Package

- Layout engineering includes gear units, couplings, guards and foundation accessories
- Dynamic review of the mechanical drive components
  - torsional and bending vibrations
  - power transmission capacity
- Increased reliability & minimized noise and vibration levels

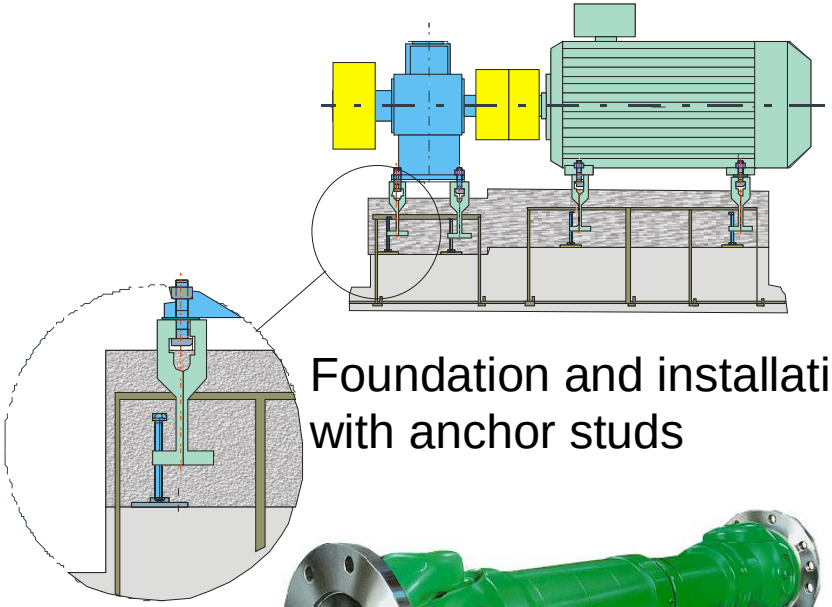


Example: Complete drive package of a forming fabric turning roll

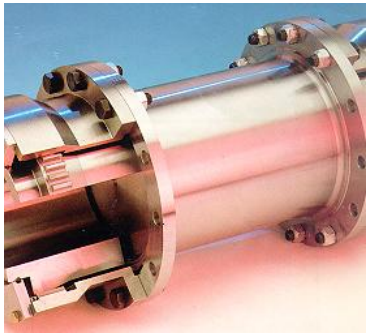
Paper Machinery Mechanical Drive
Other components



Gear coupling and cover



Foundation and installation with anchor studs



Gear coupling with spacer and cover

Universal shaft and cover

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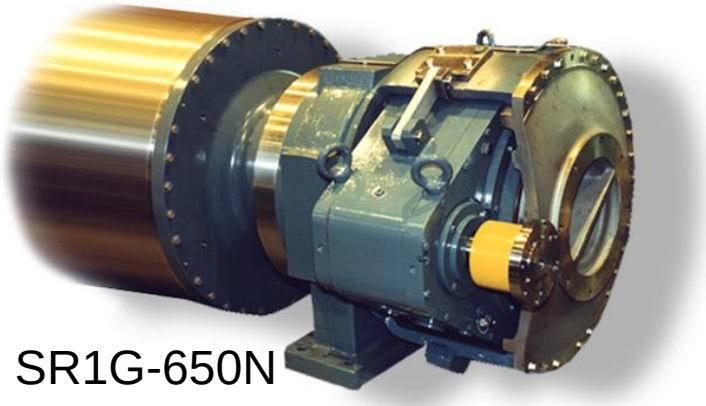
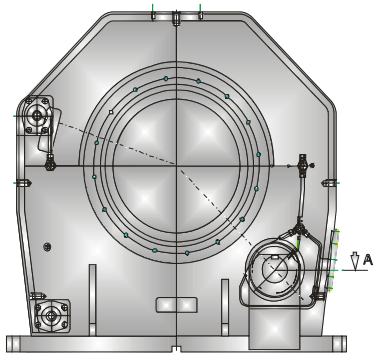
Suction roll gear units

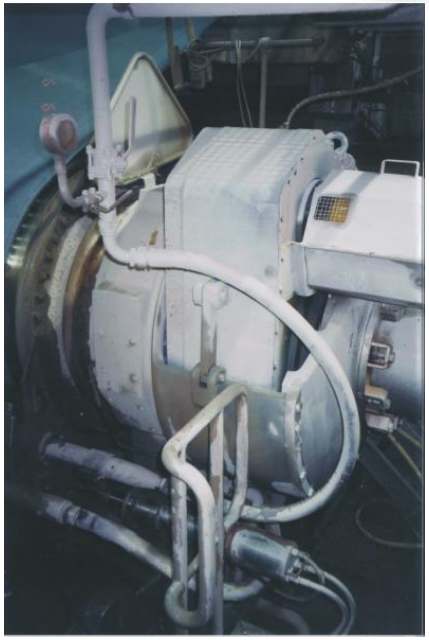


SR1G-650N



MSR1G-750

SR-650-1



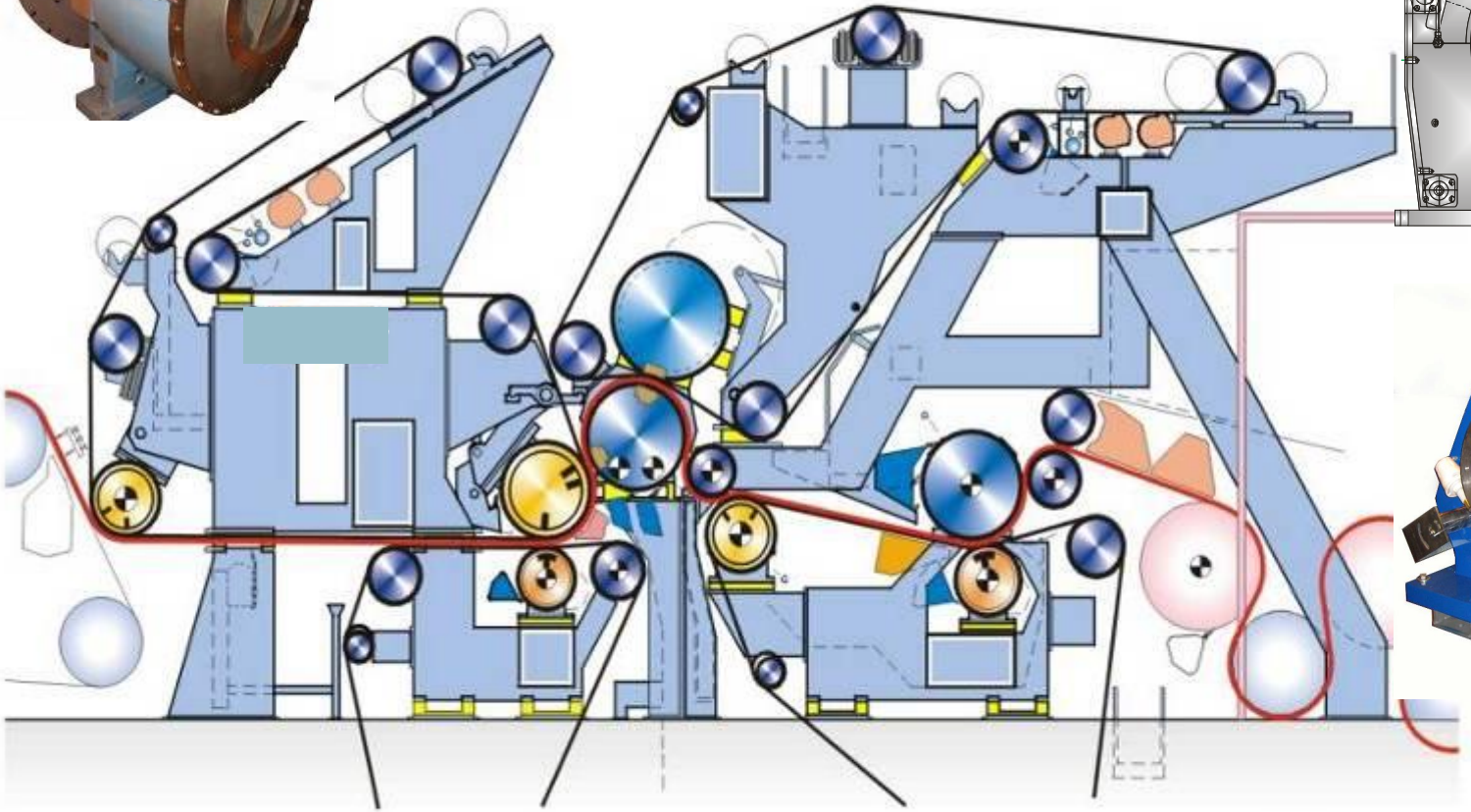
TLA-99

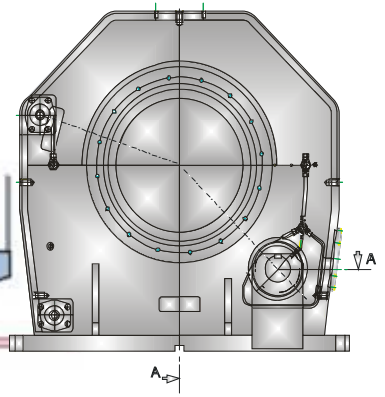
TLA-66HS

MSR1G-530

Wire Section and Drives

Press Section and Suction Roll Drives





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Press Section and Suction Roll Drives

Old Suction roll gear units TLA, TLB and TLC

- Manufactured since 1974
- Drive solution to suction rolls of wire and press sections up to web speed 1200 m/min, HS-types up to 1600 m/min
- Shaft-mounted gear unit which is integrated to roll
- HS-type equipped with axially loaded LSS bearings
- Gear unit is designed as per customer's requirements, i.e. transmission ratio, power requirements and drive point
- TLB is 2-stage gear unit and TLC is 3-stage gear unit
- Gear unit is connected to central lubrication system of paper machine

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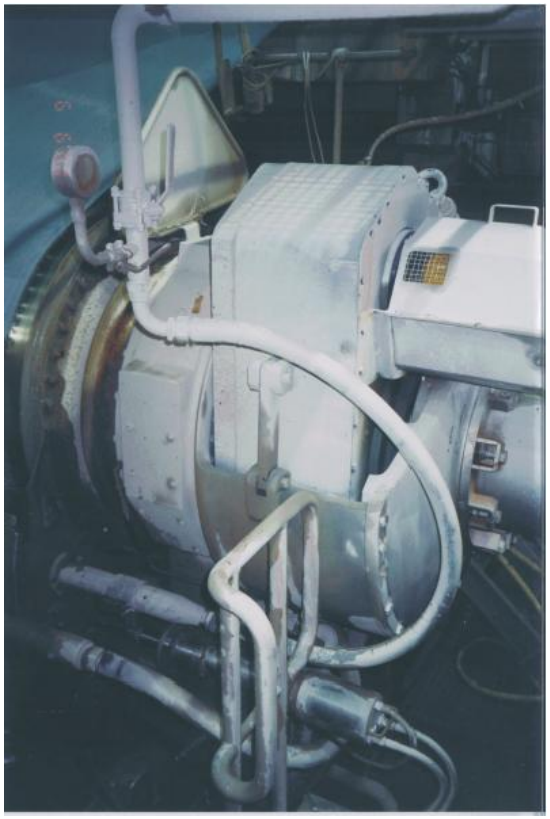
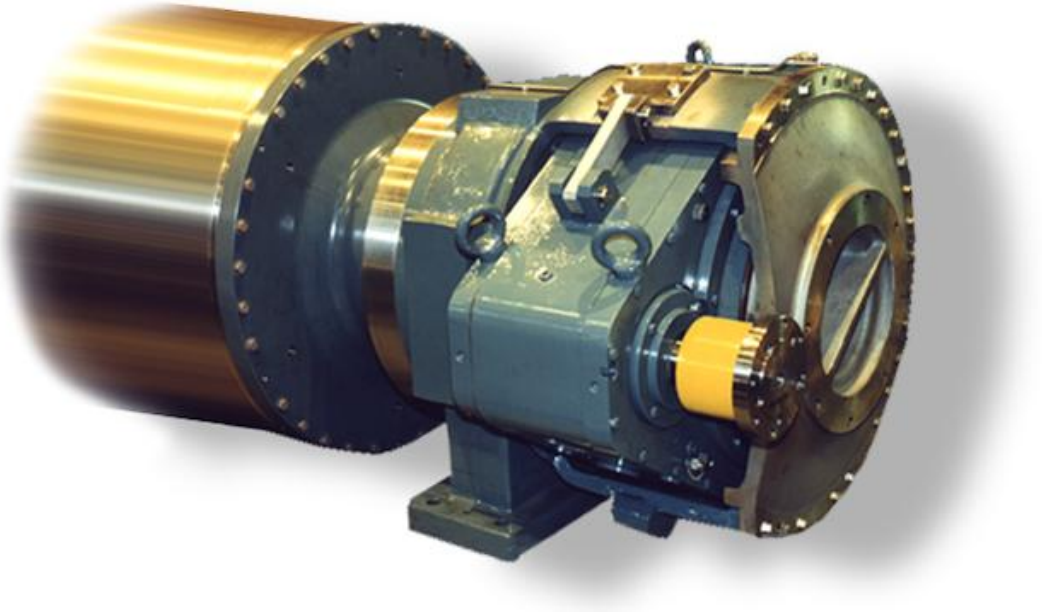
Old TLA-gears



- TLA-300
- TLA-355
- TLA-420
- TLA-470
- TLA-500
- TLA-560
- TLA-630
- TLA-710
- TLA-44
- TLA-55
- TLA-66
- TLA-77
- TLA-88
- TLA-99
- TLA-44HS
- TLA-55HS
- TLA-66HS
- TLA-77HS
- TLA-88HS
- TLA-99HS

Old SR1G-xxxN suction roll gears

- Gear sizes 325; 350; 450; 525; 650; 700; 800
- Gear ratio's from 1.5 to 5.7
- Machine speed from 5200 to 7200 FPM
- Maximum NRL power = 2000 HP
- Gearwheels are double helical

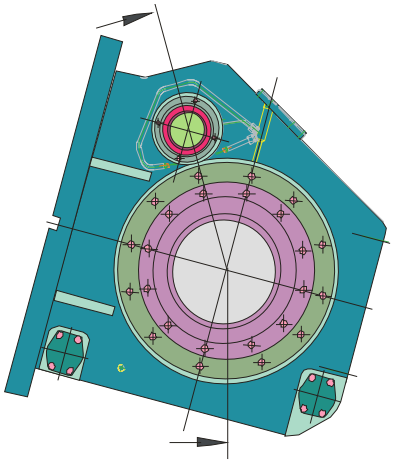


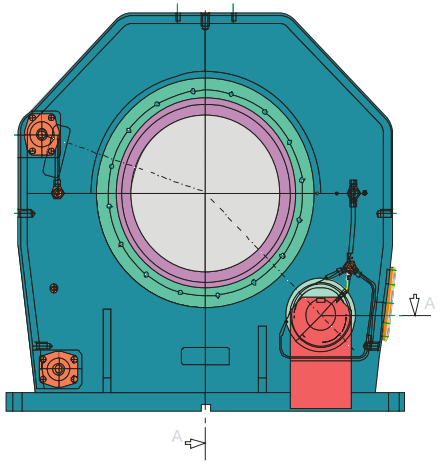
MSR1G- Suction Roll Gears

MSR1G-530
I= 2.6…4.8:1, Pnrl < 541 kW

MSR1G-630 – new sizes

MSR1G-750
I= 3.5…7.5:1, Pnrl < 1240 kW





MoventasSuctionRollGear- gear units MSR1G

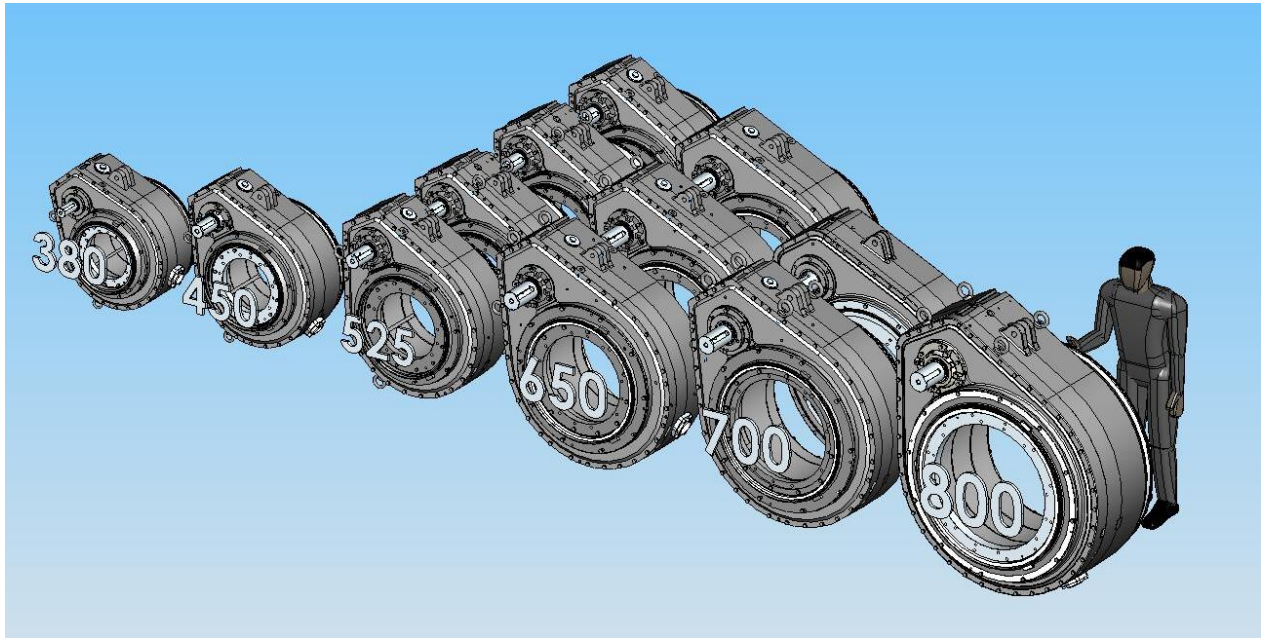
- Manufactured since 2004
- Drive solution which is especially designed to suction rolls of press section of wide (>9 m) and fast (> 1800 m/min) machines
- Foot-mounted gear unit which is integrated to the roll serves also as bearing pedestal of the roll
- Gear unit's internal coupling design and sealing solutions allow tilted positions during cantilevering as well as movements of the roll
- Gear unit is designed as per customer's requirements
- Gear unit is connected to central lubrication system of a paper machine

New SuctionRoll gear units SR

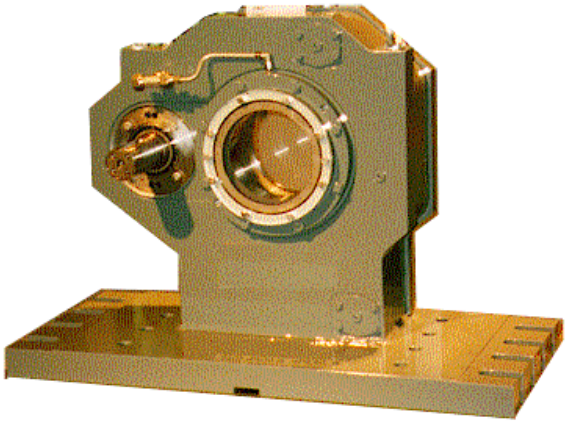
- Manufactured since 2007
- Drive solution to suction rolls of wire and press sections with wide speed range up to 2500 m/min
- Shaft-mounted gear unit which is integrated to the roll
- Axially loaded LSS bearings
- Smaller gear unit sizes enable return flow of roll bearing's lubricating oil through gear unit
- Standard gear serie with standardized drive positions
- Gear unit is connected to central lubrication system of a paper machine

NEW SR-xxx SERIE and corresponding of suction roll gears

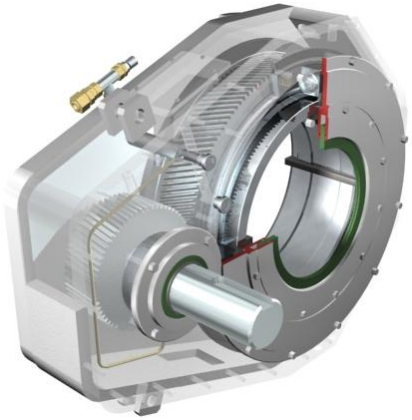
- SR-380-S
- SR-450-S
- SR-525-1
- SR-525-2
- SR-525-3
- SR-525-S4
- SR-650-1
- SR-650-2
- SR-650-3
- SR-700-1
- SR-700-2
- SR-800-1



Integrated roll gear units for deflection-compensated roll



1RG-50



ZSCG-10590

2x1BPG-800

1CRG-500

ZSPG-590

2x1CBPG-900

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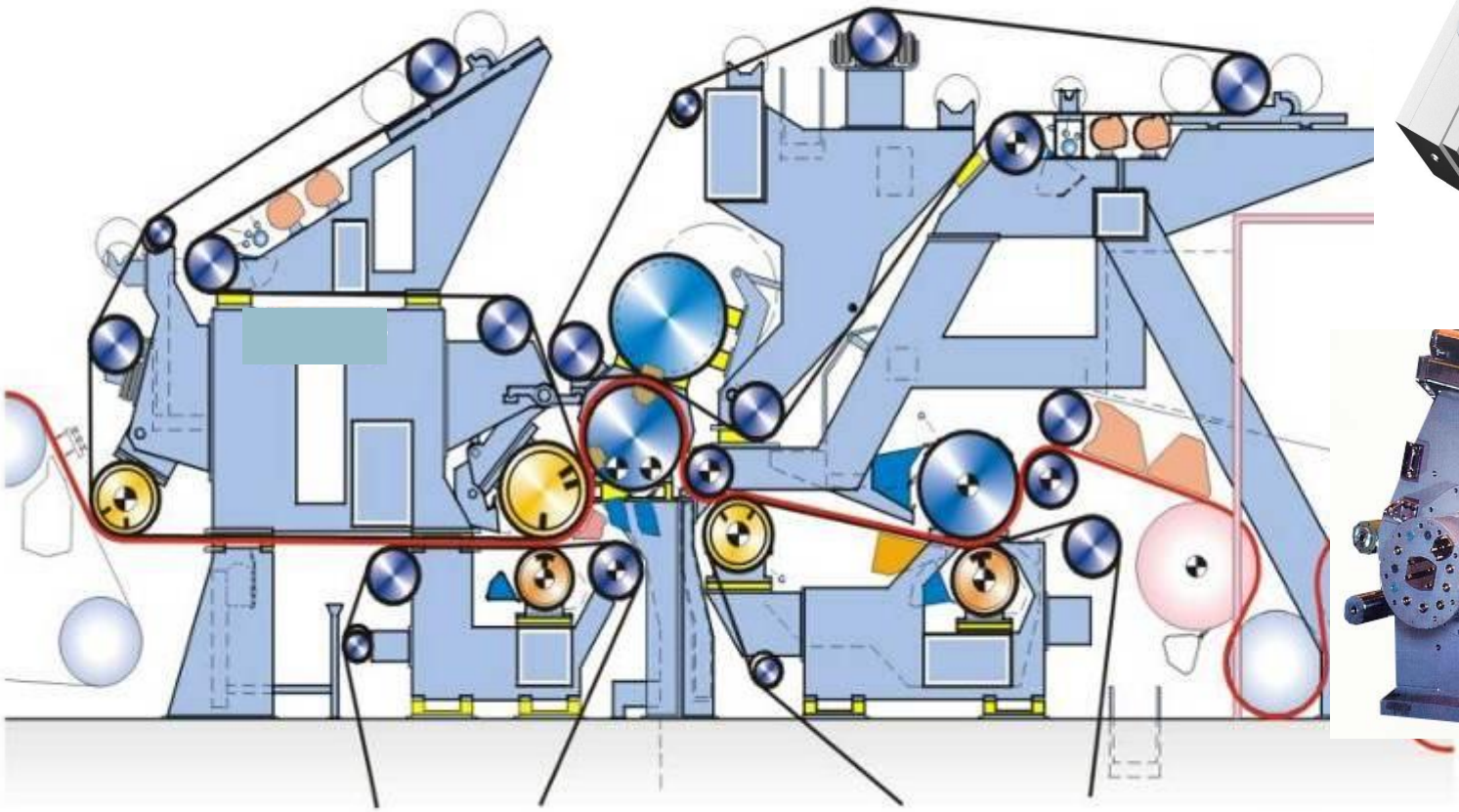
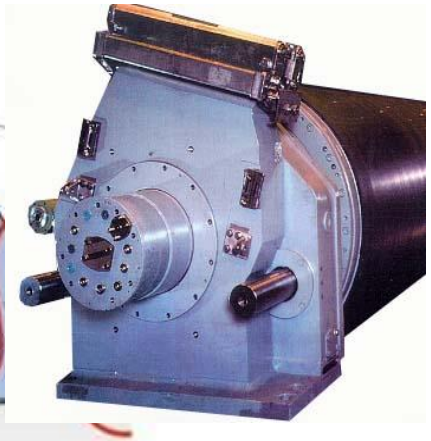
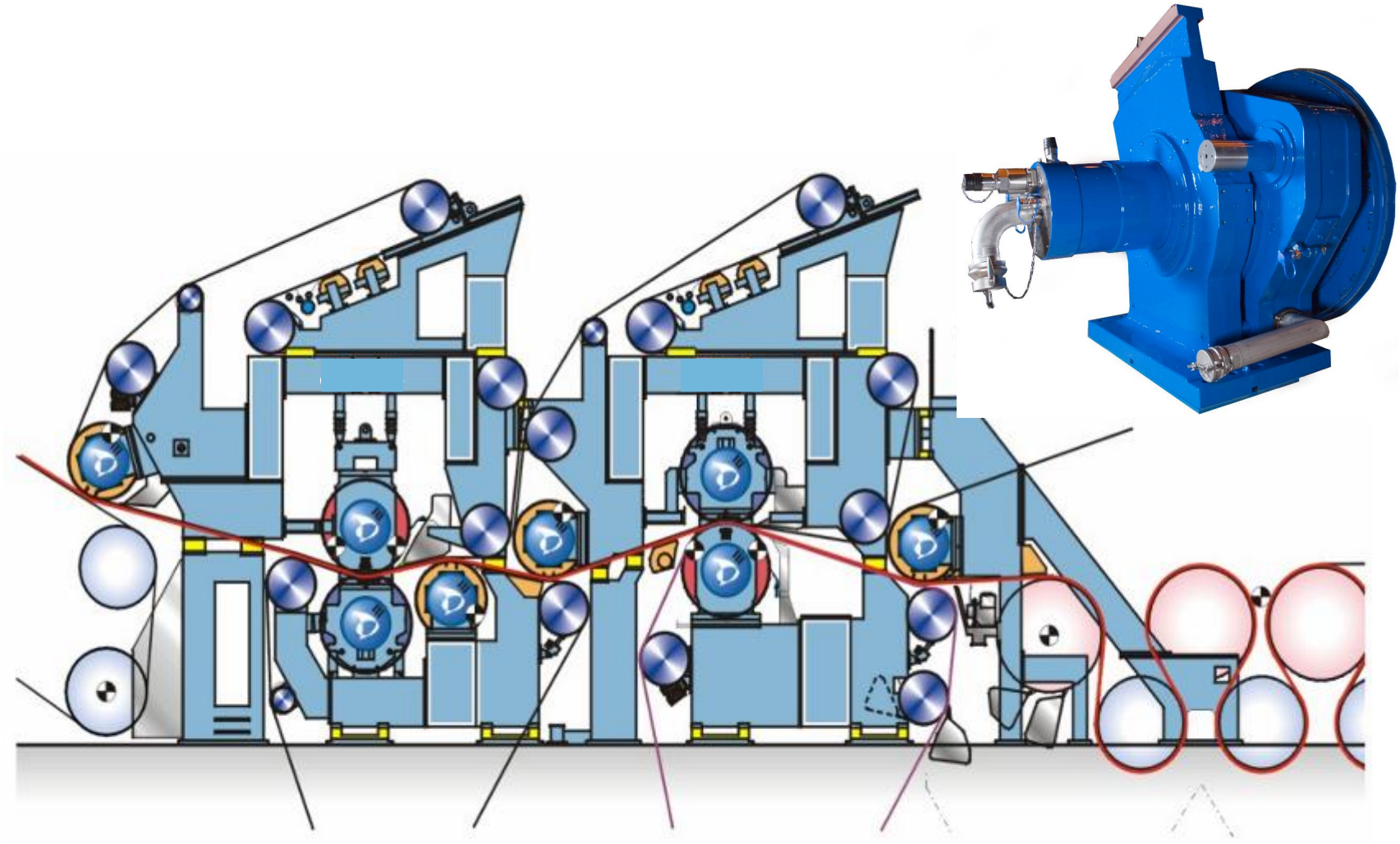
Press Section and Integrated Roll Drives



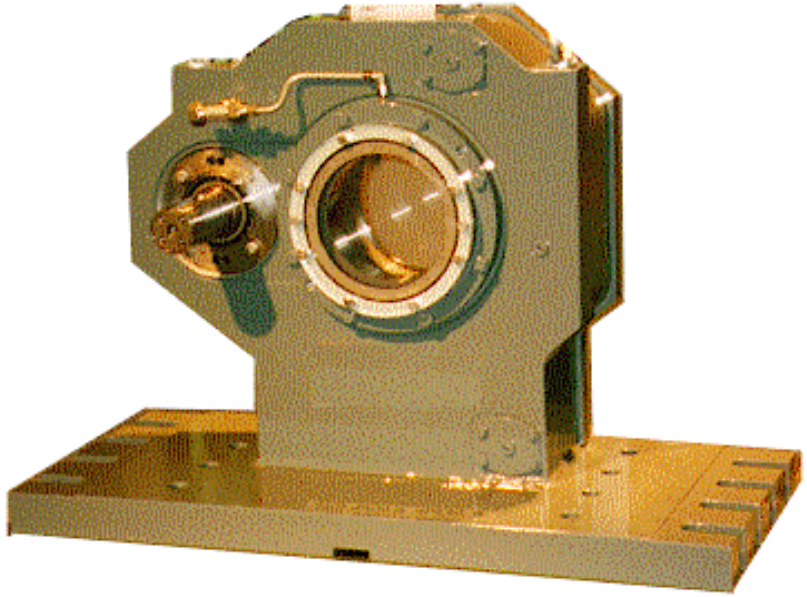


Press Section and Long Nip Roll Drives



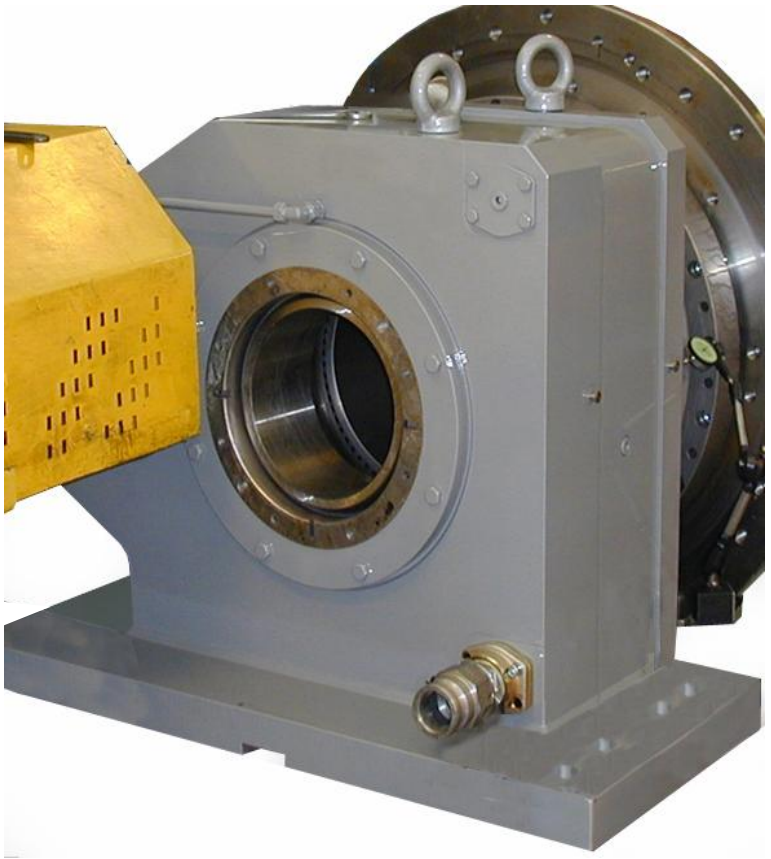
RollGear- gear units RG

- Manufactured since 1979
- Drive gear unit to deflection compensated rolls up to web speed 1800 m/min
- Foot-mounted gear unit, which is integrated to the roll, serves also as a bearing pedestal of the roll
- Alignment of the HS-shaft and tooth contact of the gear unit remains unchanged regardless of the nip loads of the roll
- The gear unit's internal coupling design and sealing solutions allow the movements of the roll shell caused by deflection of the roll center shaft
- The gear unit is designed as per customer's requirements
- Suitable for roll modenizations, e.g to replace triple ring bearing
- Lubrication oil to the gear unit is supplied from the hydraulic system of the roll

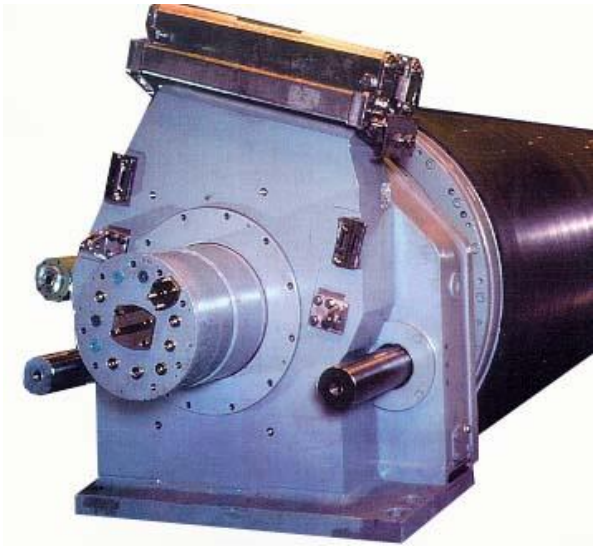


CompactRollGear- gear units CRG

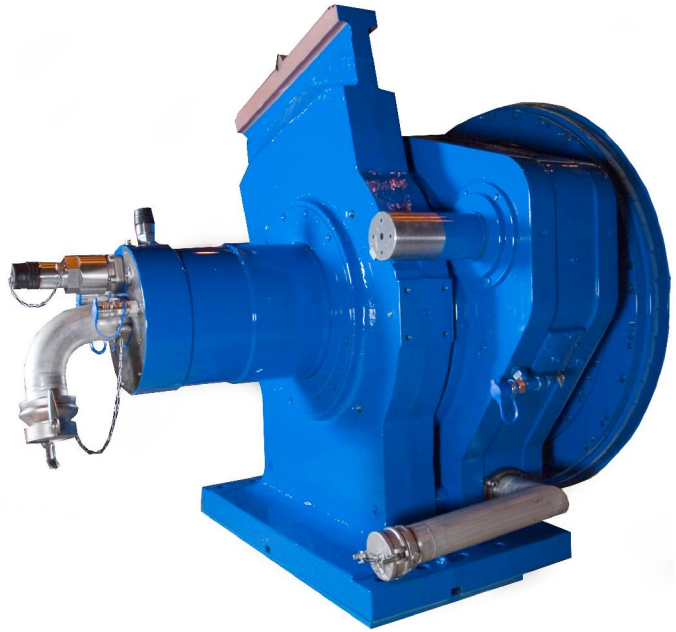
- Manufactured since 2002
- Drive solution to deflection compensated rolls up to web speed 2500 m/min
- Foot-mounted gear unit which is integrated to the roll serves also as bearing pedestal of the roll
- Alignment of the HS-shaft and tooth contact remains unchanged regardless of the nip loads
- The gear unit's internal coupling design and the patented sealing solution allow larger movements of the roll shell caused by deflection of the roll center shaft than RG-gear unit.
- The gear unit is designed as per customer's requirements
- Lubrication oil to the gear unit is supplied from the hydraulic system of the roll



Integrated Roll Gear Units for deflection-compensated Long Nip rolls



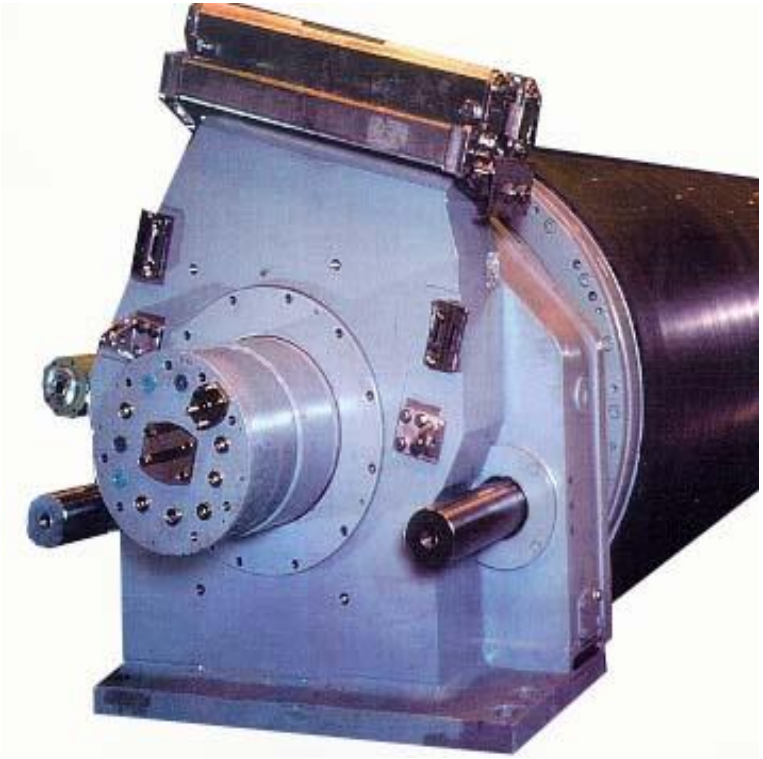
BPG-gear



CBPG-gear

BeltPressGear gear units BPG

- Manufactured since 1994
- Drive solution for long-nip deflection compensated rolls up to web speed 1200 m/min
- 1- or 2-motor driven gear unit
- Foot-mounted gear unit which is integrated to the roll and installed to the bearing pedestal of the roll
- The gear unit's internal coupling design and sealing solutions allow the movements of the roll shell caused by deflection of the roll center shaft
- The gear unit is designed as per customer's requirements
- Lubrication oil to the gear unit is supplied from the hydraulic system of the roll



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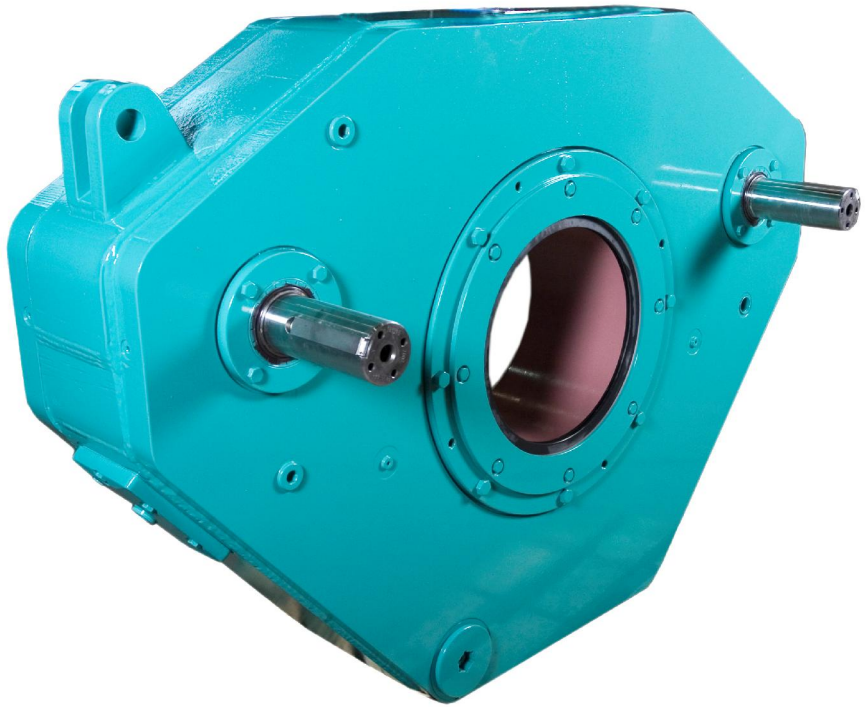
CompactBeltPressGear gear units (CBPG-)

- Manufactured since 2003
- Drive solution for long-nip deflection compensated roll up to web speed 2500 m/min
- 1- or 2-motor driven gear unit
- foot-mounted gear unit which is integrated to the roll and installed to the bearing pedestal of the roll
- The gear unit's internal coupling design and the patented sealing solution allow larger movements of the roll shell caused by deflection of the roll center shaft than BPG-gear unit.
- The gear unit is designed as per customer's requirements
- Lubrication oil to the gear unit is supplied from the hydraulic system of the roll

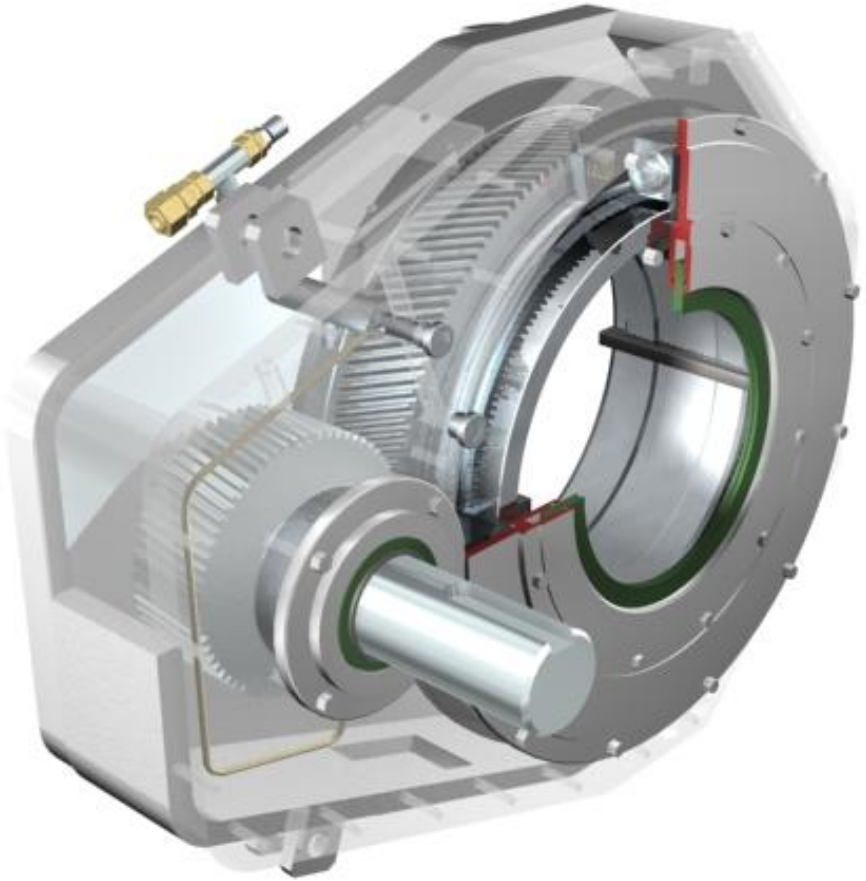
CC-roll gear unit 2x1CCG-590

- Shaft mounted twin motor drive unit
- External dimensions same as ex. Beloit unit
- Roll shell support/roll bearing sleeve to be modified for enhanced sealing
- Longer internal bearing support distance for more stable run (of the gear unit)

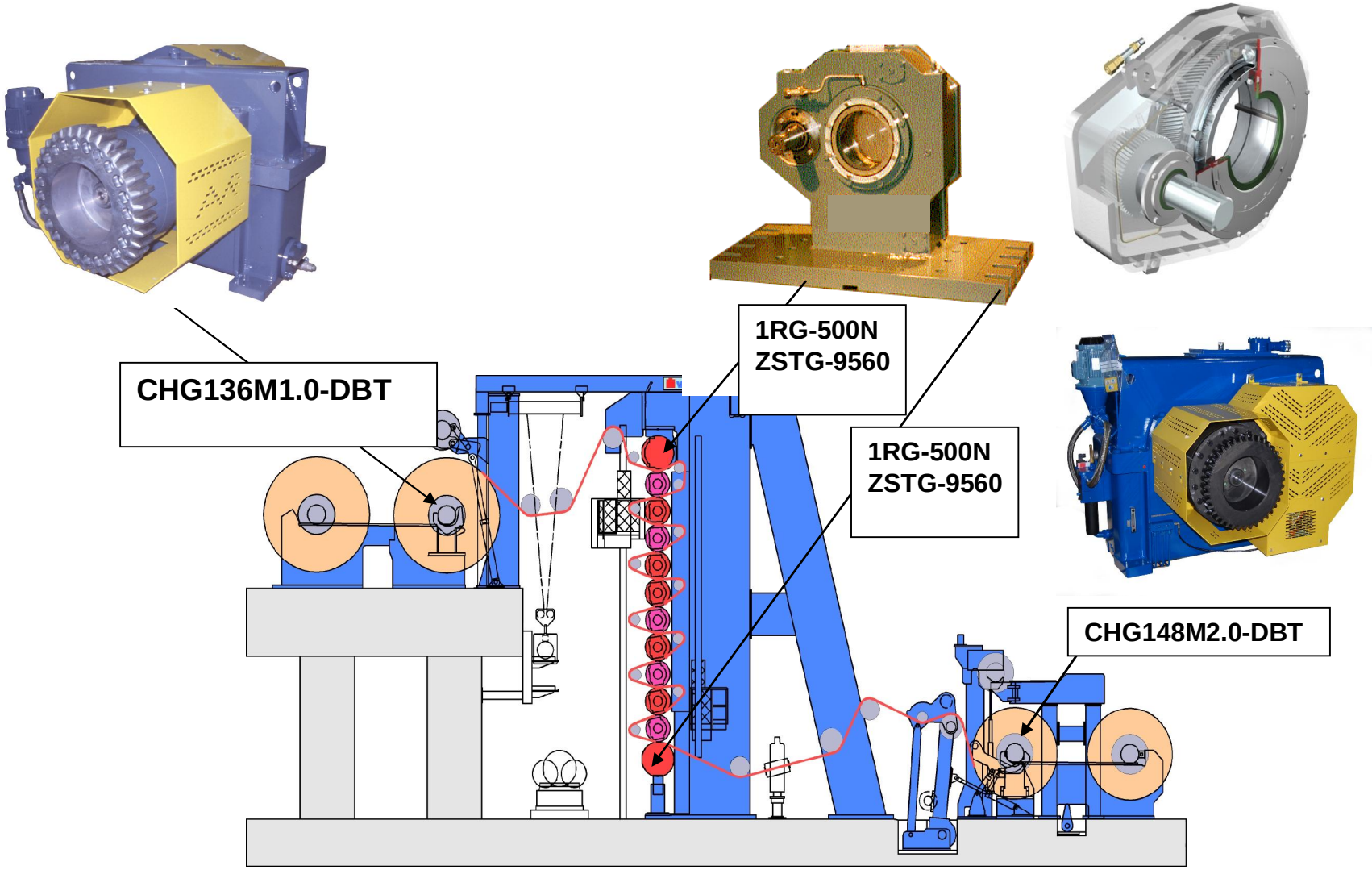


ZSCG- and ZSTG-gears for deflection-compensated rolls with self-loading adapting shell

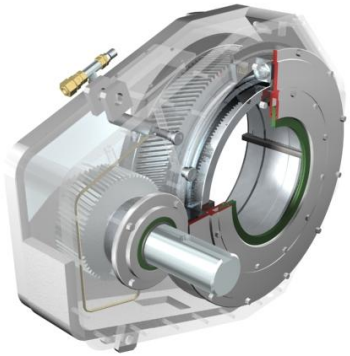
- ZSCG-1390
- ZSCG-2430
- ZSCG-3460
- ZSCG-4455
- ZSCG-5480
- ZSCG-6505
- ZSCG-7530
- ZSCG-8560
- ZSCG-9560
- ZSCG-10590
- ZSCG-11650

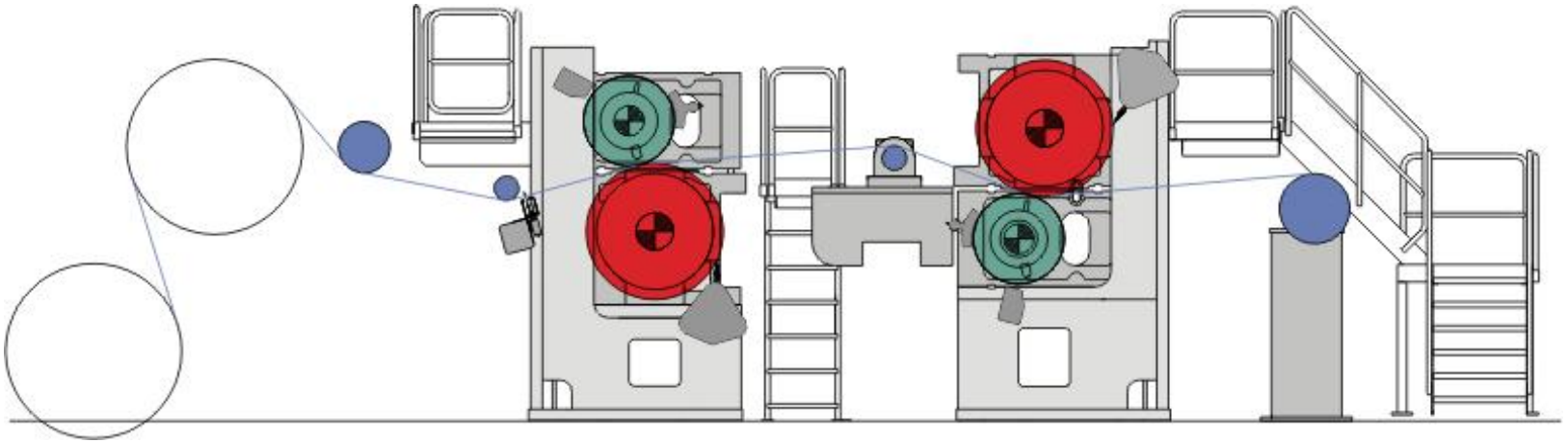


Super Calender and Drives



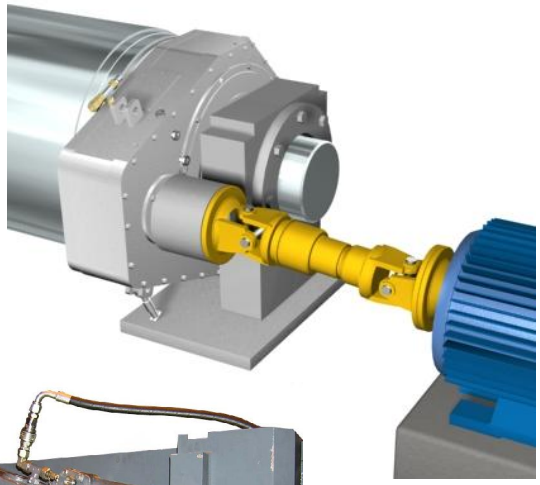
Soft Calender and Drives

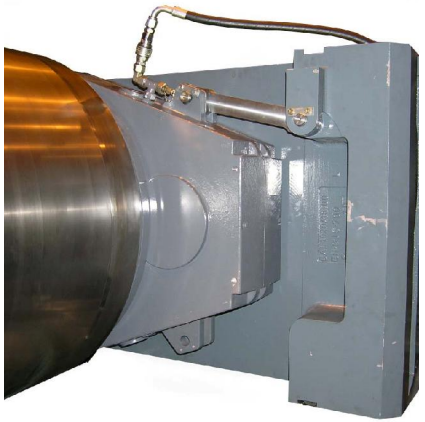


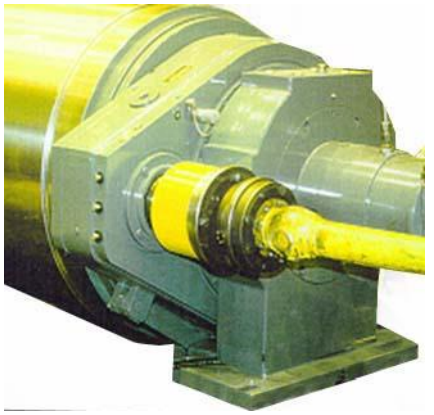


ZG-gear units

- Manufactured since 1989
- Drive solution for deflection compensated rolls with moving or solid shells of press and calender sections up to web speed 2500 m/min
- Shaft-mounted gear unit which is integrated to the roll
- In calender applications the gear unit can be turned so that the HSS is located symmetrically on either side of the bearing pedestal.
- Axially loaded LSS bearings
- Standardized gear unit serie with standardized drive positions
- Lubrication oil to the gear unit is supplied from the hydraulic system of the roll







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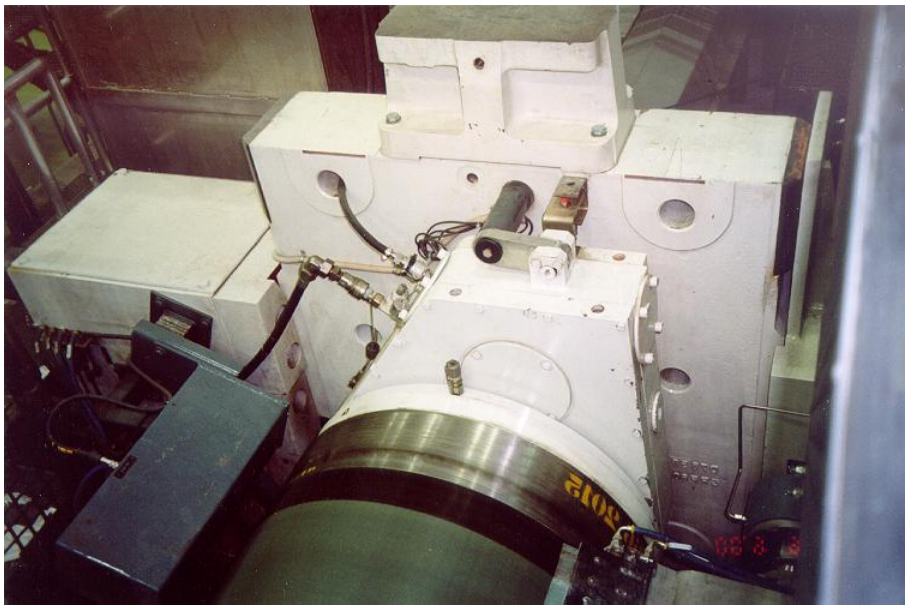
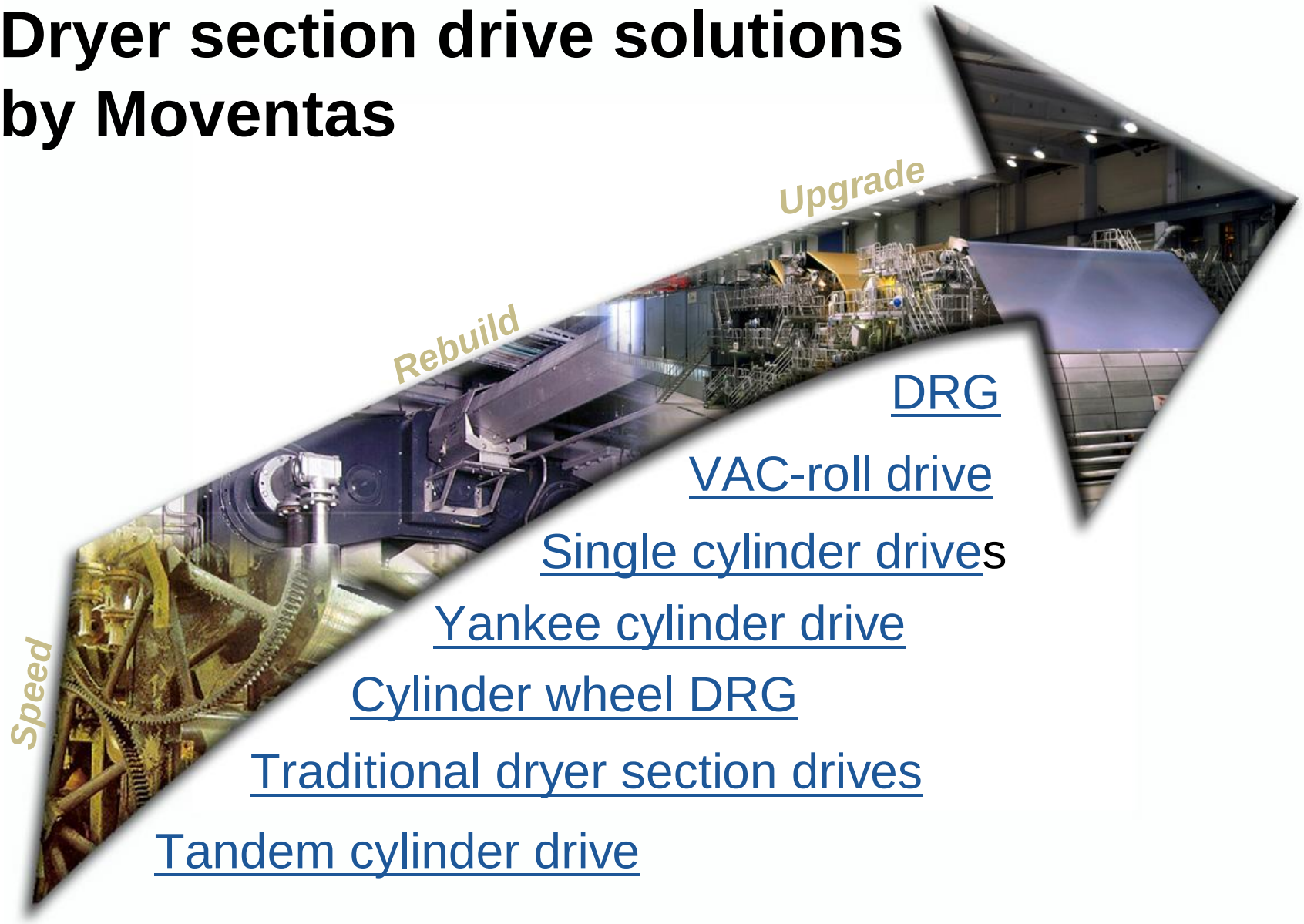
ZS-gears



Dryer section drive solutions by Moventas



Dryer section drive solutions by Moventas

Shaft mounted drive units

- Single cylinder drive reducers D1PHT280 & 420, 2TC235E
- Tandem drive units 3TKC235 & 3TKC285
- Yankee cylinder drive units TMG- & S2GH-series

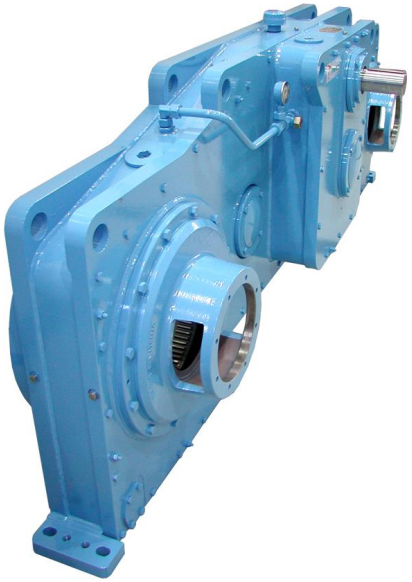
Frame drive systems

- Single cylinder ”ready to mount” units 1VCT, 2CEV & 2CEH
- Tailored frame drive systems

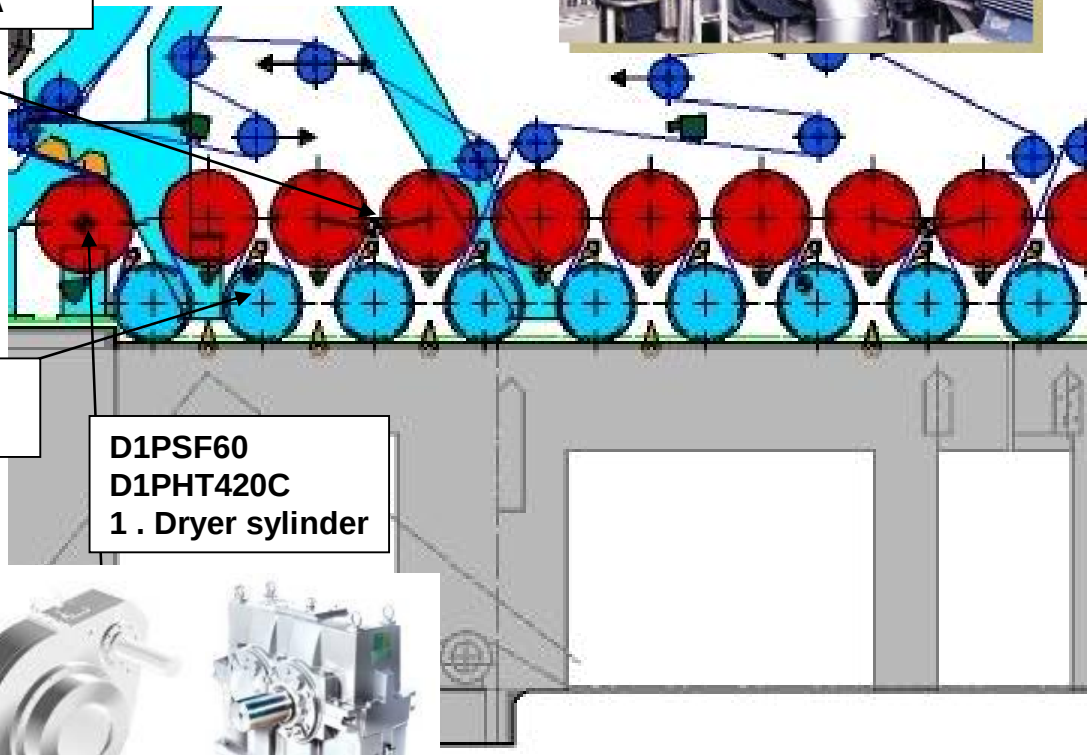
The DRG-drive units

- ”Ready to mount”, ”off-board” DRG, e.g. DRG-2100H
- DRG supporting dryer cylinder bearings
- Frame DRG
- Cylinder wheel DRG-module for rebuilds

Dryer section drives



DRG 2100
Dryer grup A



D1PHT420V
Dryer grup B

D1PSF60
D1PHT420C
1 . Dryer sylinder

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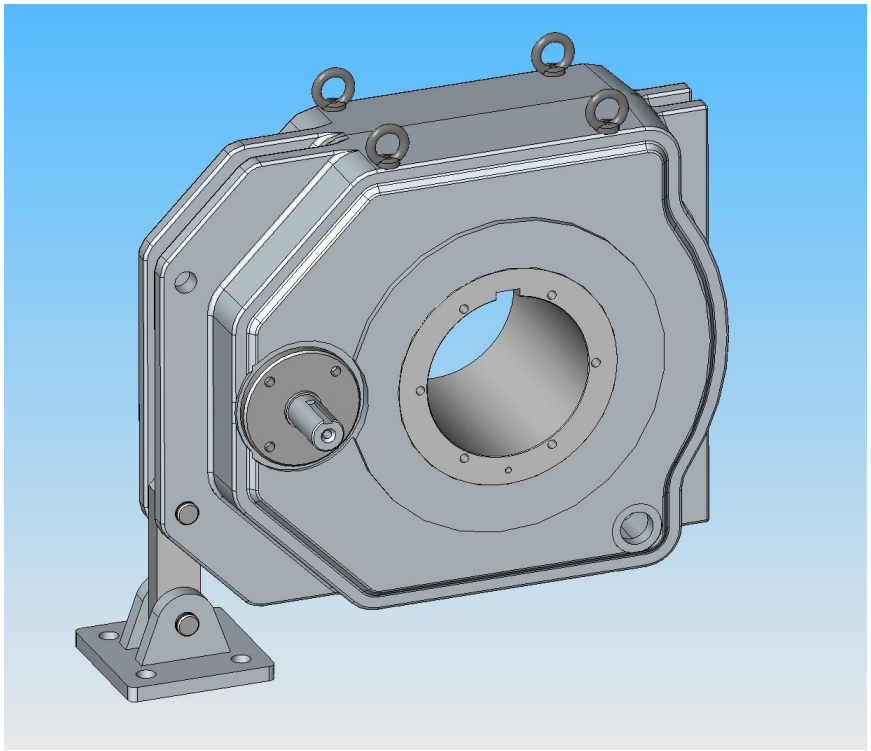
Shaft mounted reducer D1PHT280



- Journal diameter 150...240mm
- Gear ratio i=4,5:1 ... 11,5:1
- Mounting positions ”8AM – 4PM” o’clock
- Pre-loaded main bearings (by springs)
- To be connected to c-lube system
- Simple & reliable construction
- Recommended for small & medium size PM
- Easy installation for rebuilds

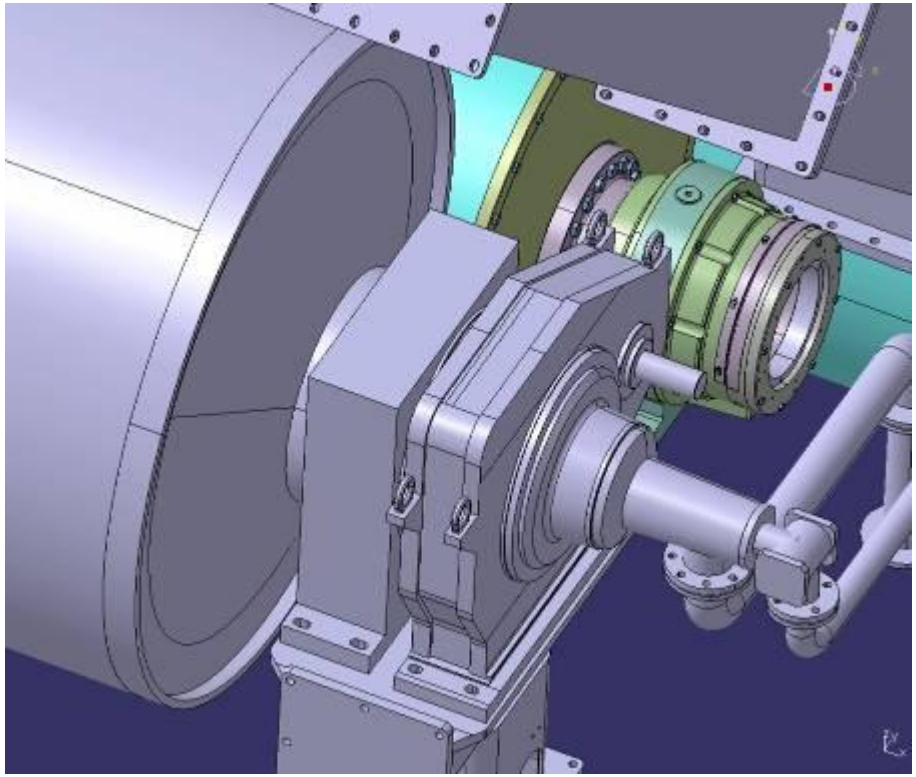
VAC-roll drive gear unit D1PHT420V

- Manufactured since 1999
- Shaft-mounted gear unit which is installed to VAC-roll shaft
- Axially loaded LSS bearings
- Suction pipe of the VAC-roll is attached to the gear unit
- Standardized gear unit with standardized drive positions
- Gear unit is connected to central lubrication system of a paper machine

Dryer cylinder drive gear unit DRG-0430

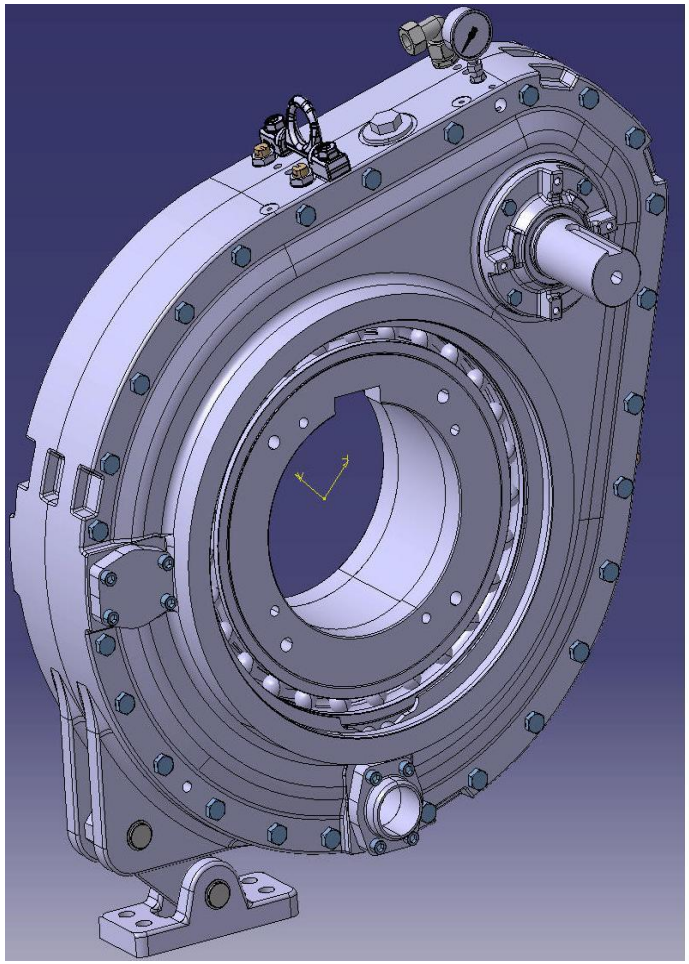
- Manufactured since 1999
- Drive gear unit to dryer cylinder
- Attached to the frame of the paper machine
- Thanks to patented coupling design the misalignments of the cylinder don’t have influence on the gear unit.
- Standardized gear unit with standardized drive positions
- Steam coupling of the dryer cylinder is attached to the gear unit
- Return oil flow from cylinder bearings goes through gear unit
- Gear unit is connected to central lubrication system of paper machine

Development of a new dryer cylinder drive gear unit



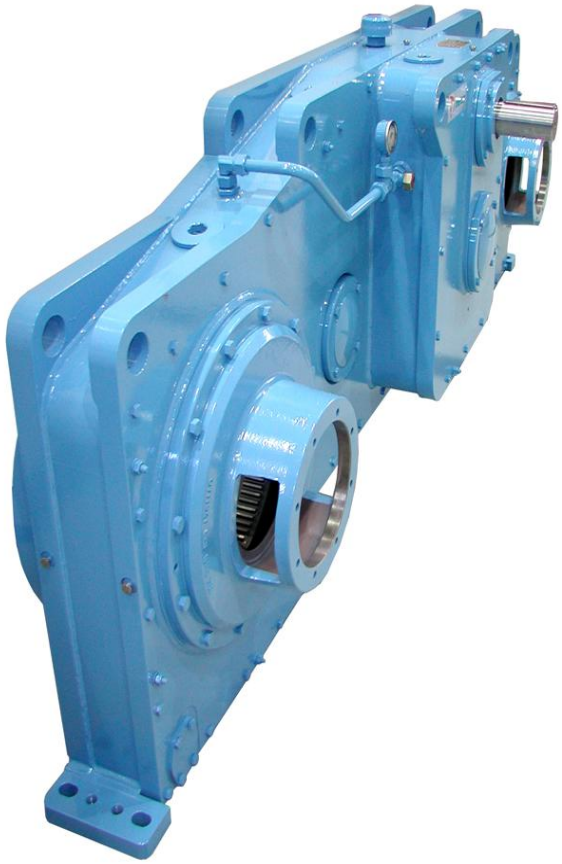
Dryer cylinder drive gear unit D1PHT420C

- Shaft-mounted gear unit which is installed to dryer cylinder shaft
- Axially loaded LSS bearings
- Part of return oil flow from cylinder bearings goes through gear unit
- Standardized gear unit with standardized drive positions
- Gear unit is connected to central lubrication system of paper machine



Dryer group drive unit DRG-2100H

- Manufactured since 1999
- Drive unit for two dryer cylinders
- Attached to the frame of the paper machine
- Transmission ratio is easy to change in rebuilds
- Thanks to the patented coupling design the misalignments of the cylinders don’t have influence on the gear unit
- The steam couplings of the cylinders are attached to the gear unit
- Return oil flow from cylinder bearings goes through gear unit
- Gear unit is connected to central lubrication system of paper machine



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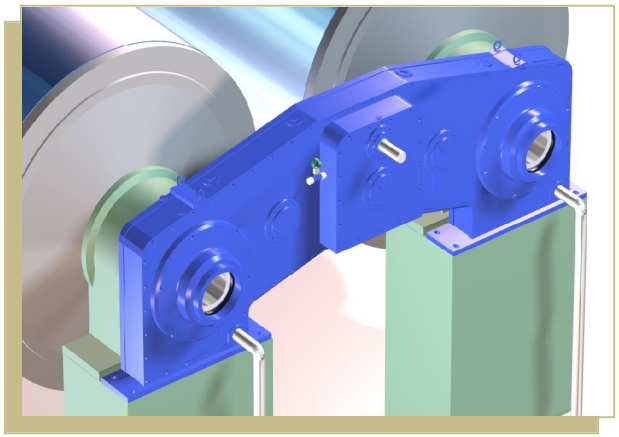
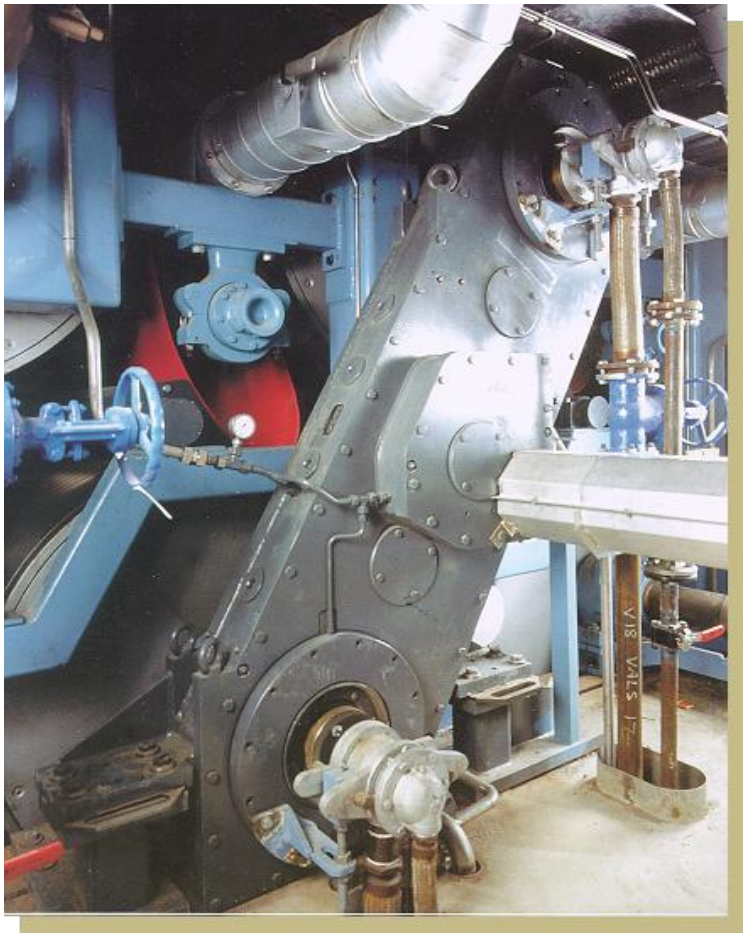
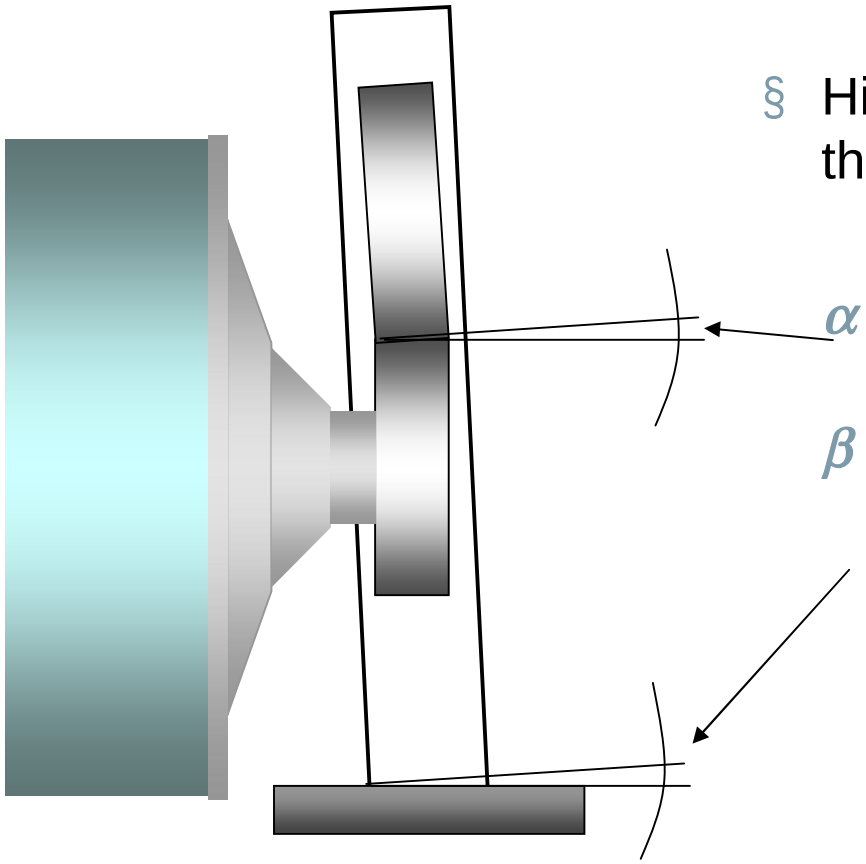
DRG

- Suitable for Open and Enclosed Gear Dryer Sections
- Complete Packages for New Machines and Machine Rebuilds





Problems with conventional gear cases



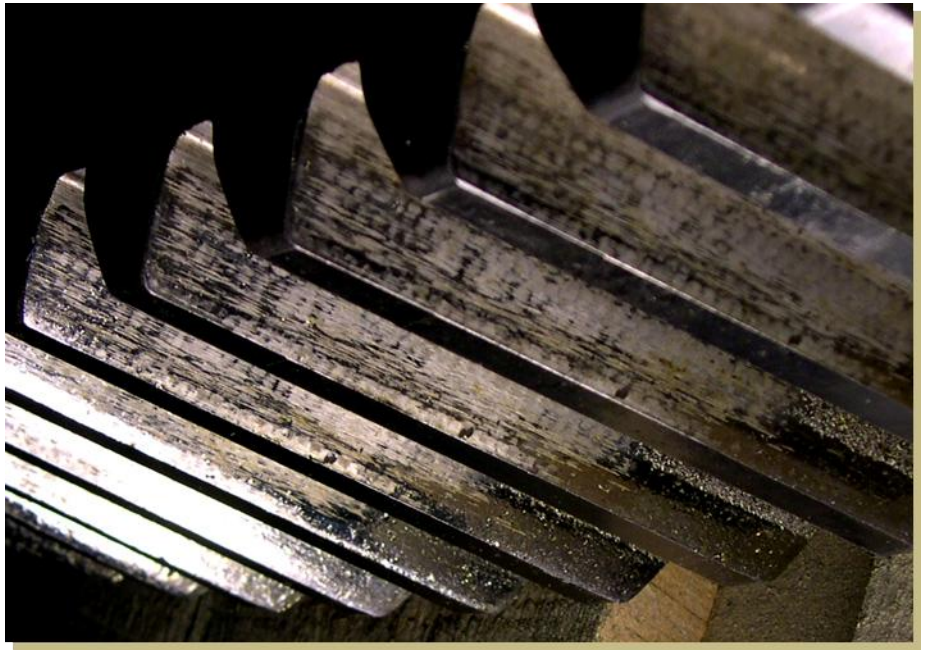
- High vibration and noise levels are the result of...

α misalignment of cylinder

β misalignment of base plates and gear cases

Typical problems in the traditional design dryer section drives

- Misalignment between gear frame and drying cylinder
- Misalignment is caused by sinking foundation, mounting inaccuracies and thermal expansions



Consequences:

- Incorrect tooth contact
- Tooth wearing problems
- High noise and vibration levels
- Bearing damages

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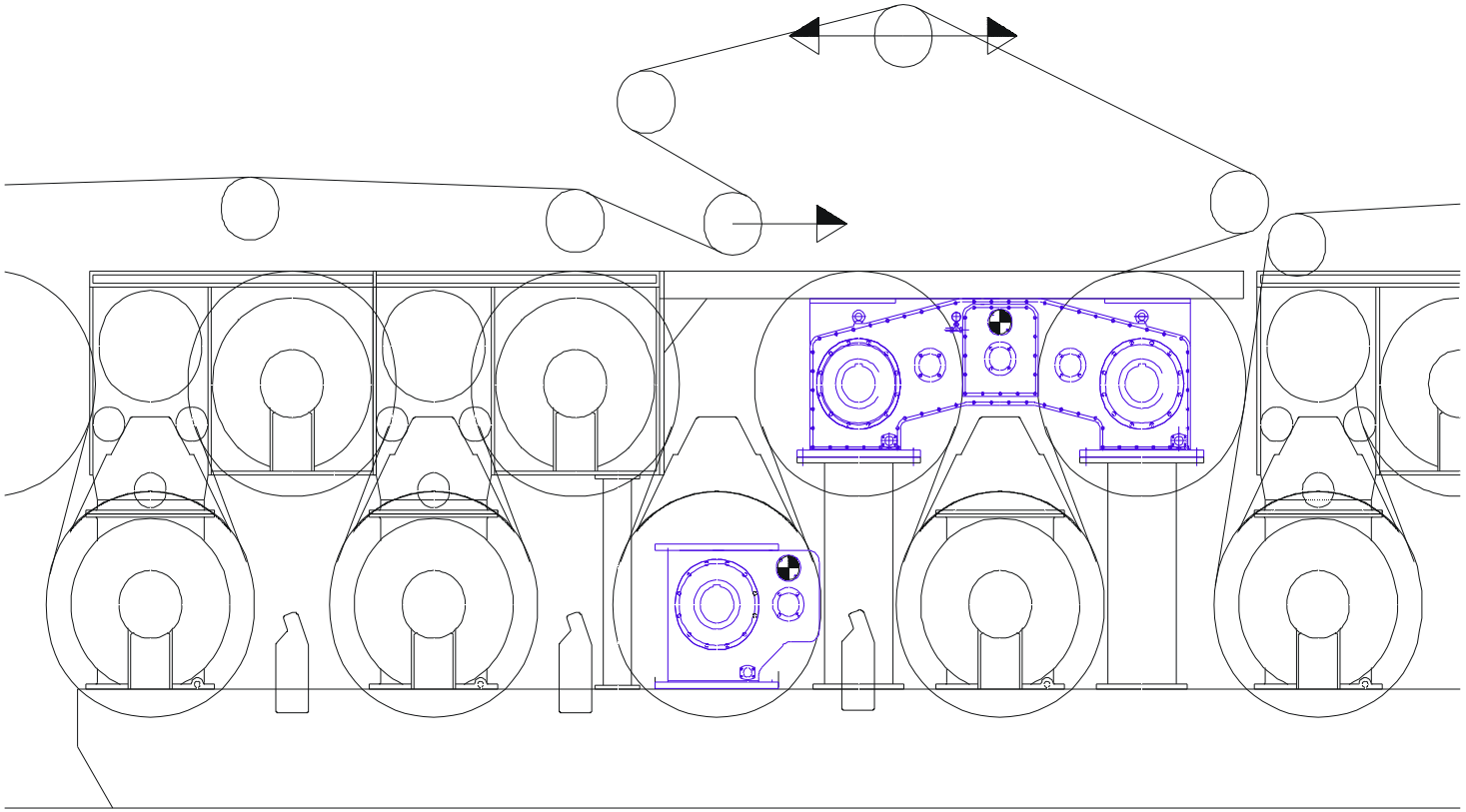
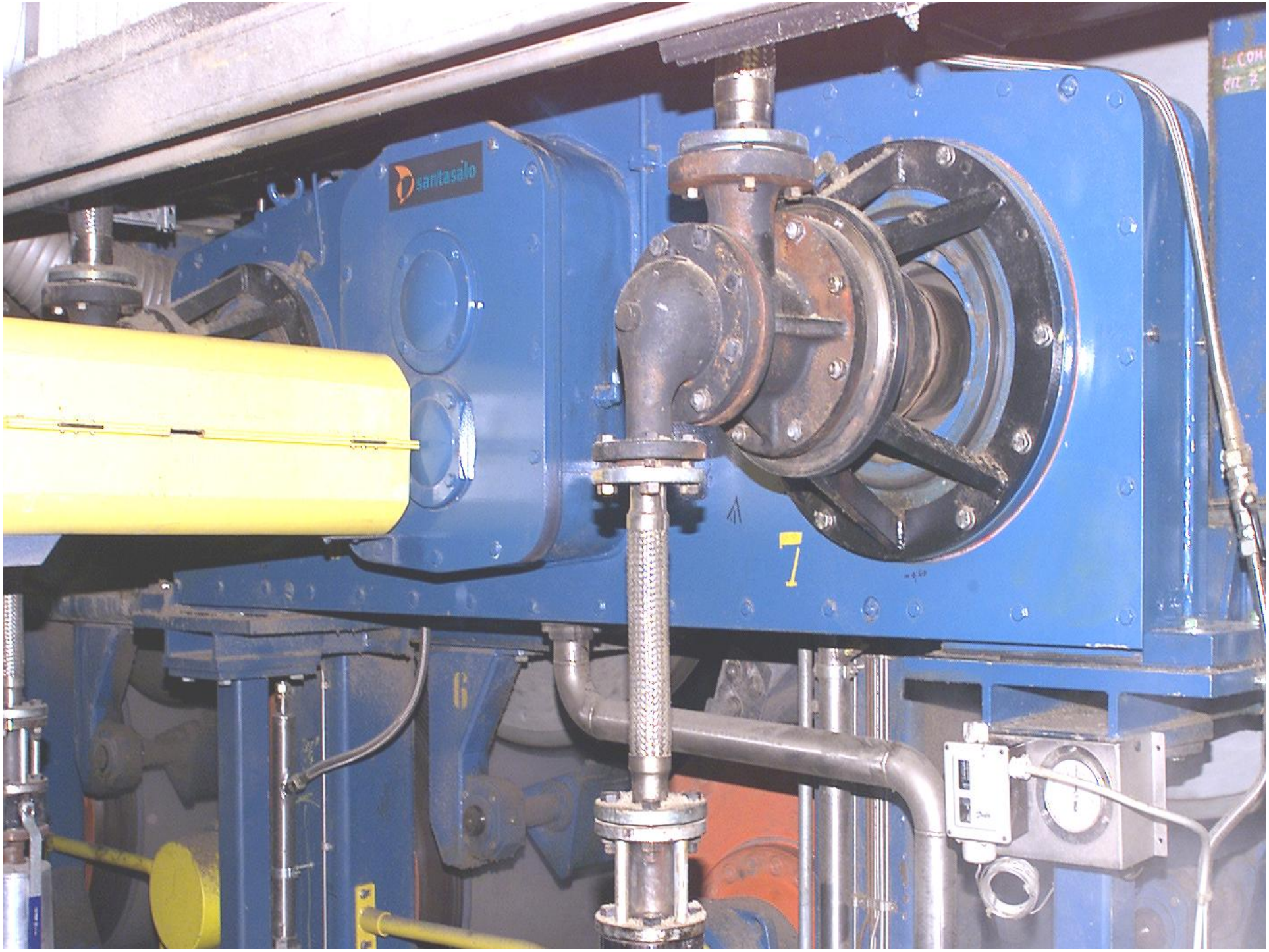
Horizontally-mounted DRG
Single-felted sections

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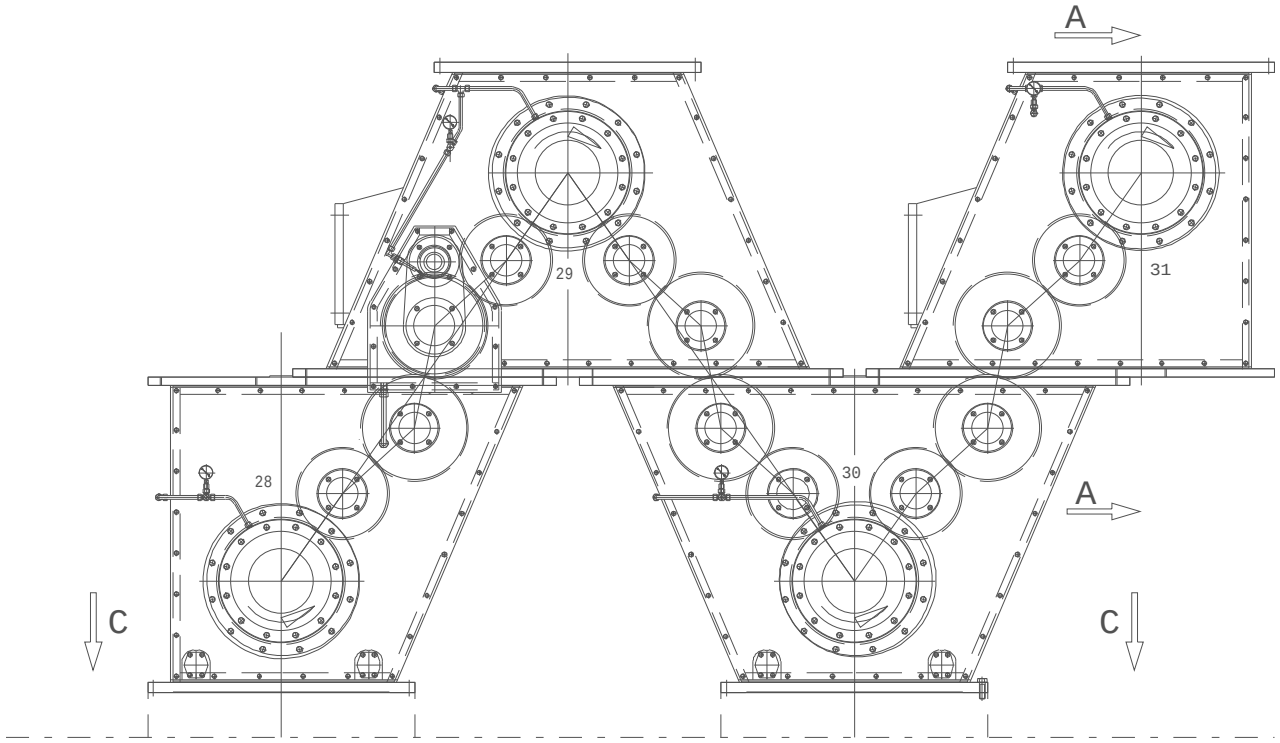
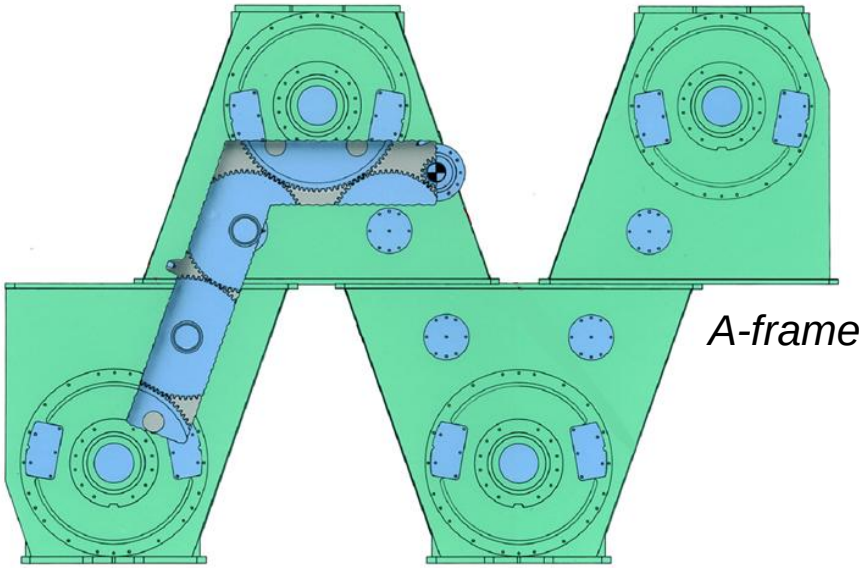
6

A-frame DRG



Traditional dryer section drives

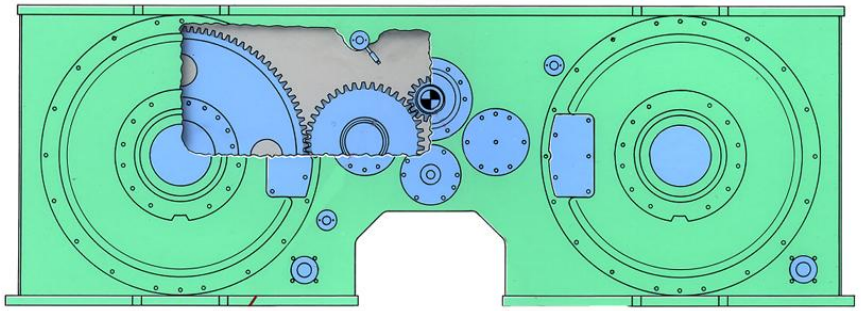
- Concept:
  - Simple, enclosed design
  - Could be equipped with intermediate speed reducer



A-frame

- Advantages
  - Gear casing is also dryer section frame
  - Safety

D-frame



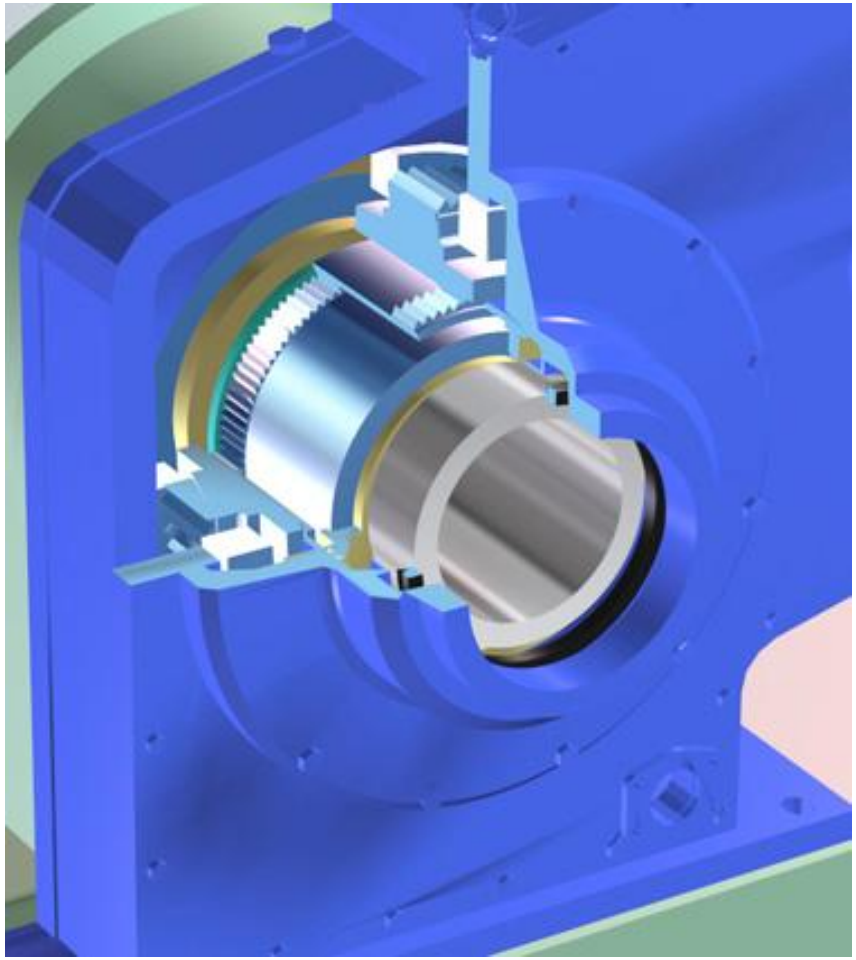
DRG-unit: Advantages

- Unique coupling design accommodates thermal expansion, mounting inaccuracies and possible base distortions.
- Low noise and vibration levels
- Simple gear ratio change
- Minimum number of electric motors and controls required
- Better air flow and faster drying, resulting in lower operating costs
- Eliminates maintenance and safety problems

DRG Design

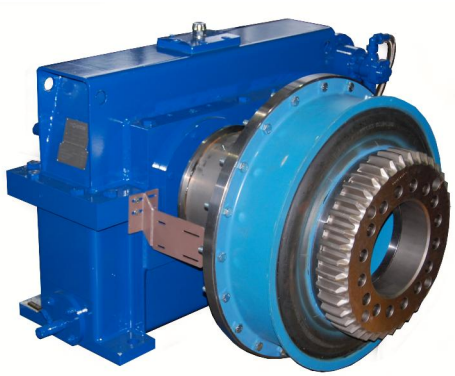
- Patented coupling arrangement connects the driving gear to the driven cylinder journal
- Power transmission capacity as high as required
- Suitable for totally felted single- and double-felt dryer sections
- Tailor-made application engineering
- Steam joint is fastened directly to gear housing
- Compact size - necessary components built in
- Connectable to paper machines condition monitoring system

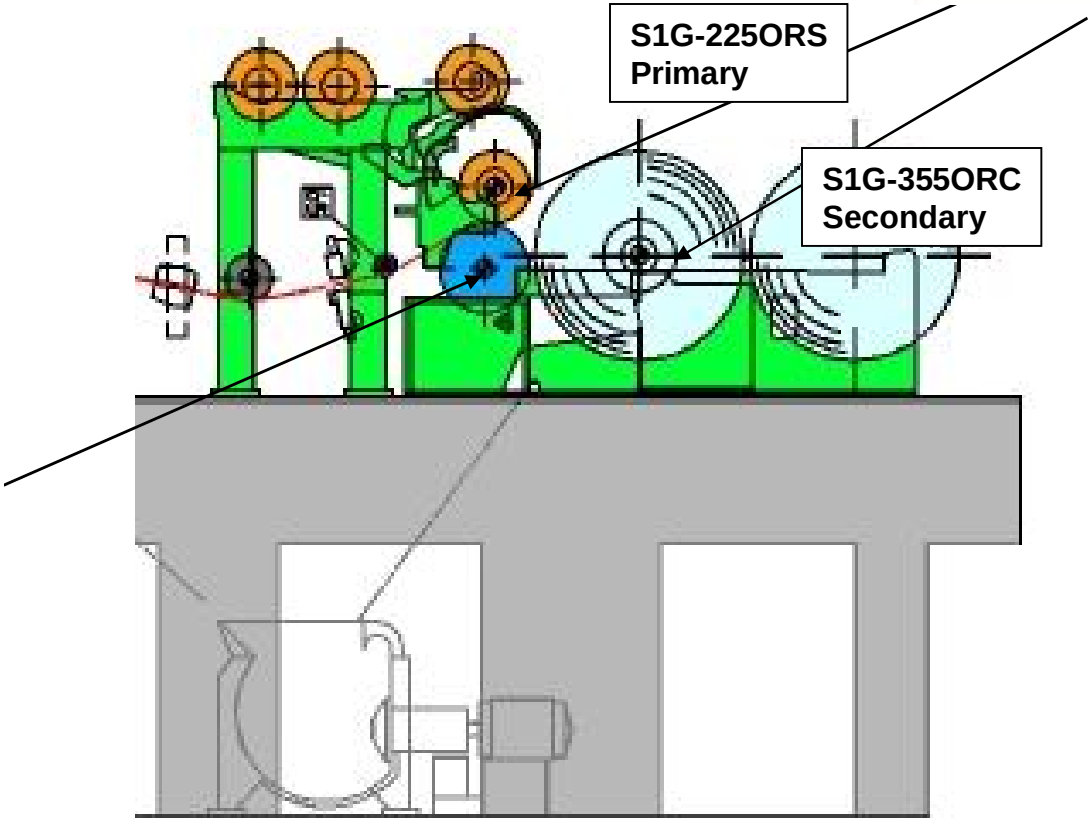
DRG Coupling Design



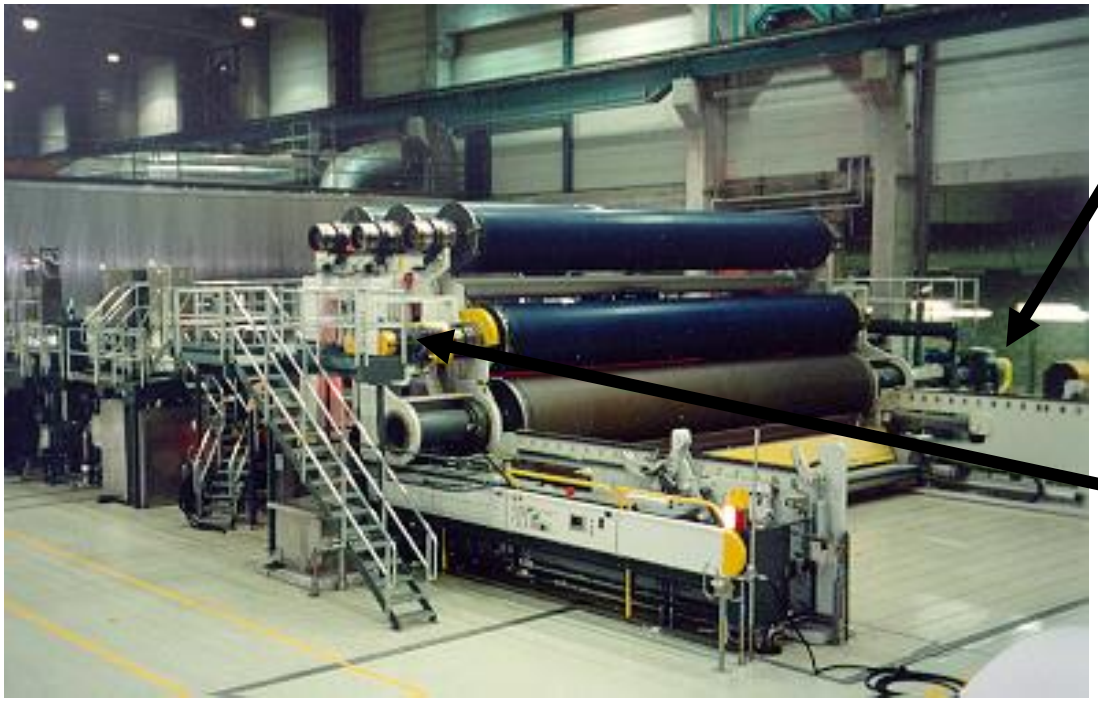
- High strength alloy steel
- Nitrided gear teeth
- Misalignment capacity
  - 3 degree angular
  - +/- 3 mm radial
  - +/- 4 mm axial
- Machine center line to journal shaft end +/- 1.5 mm
- Dryer journal centers +/- 1 mm

Reel drives

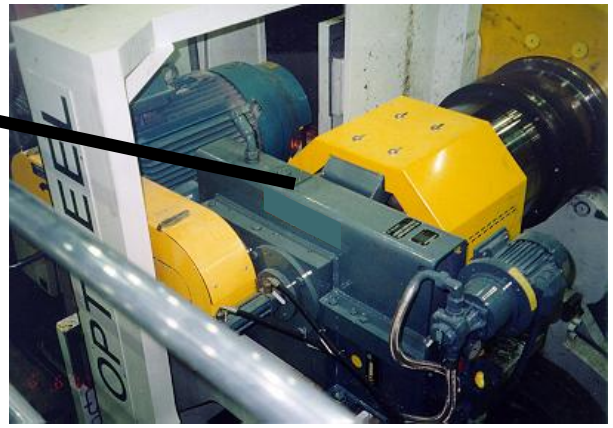




Reel



Opti-reel Secondary Drive



Opti-reel Primary Drive

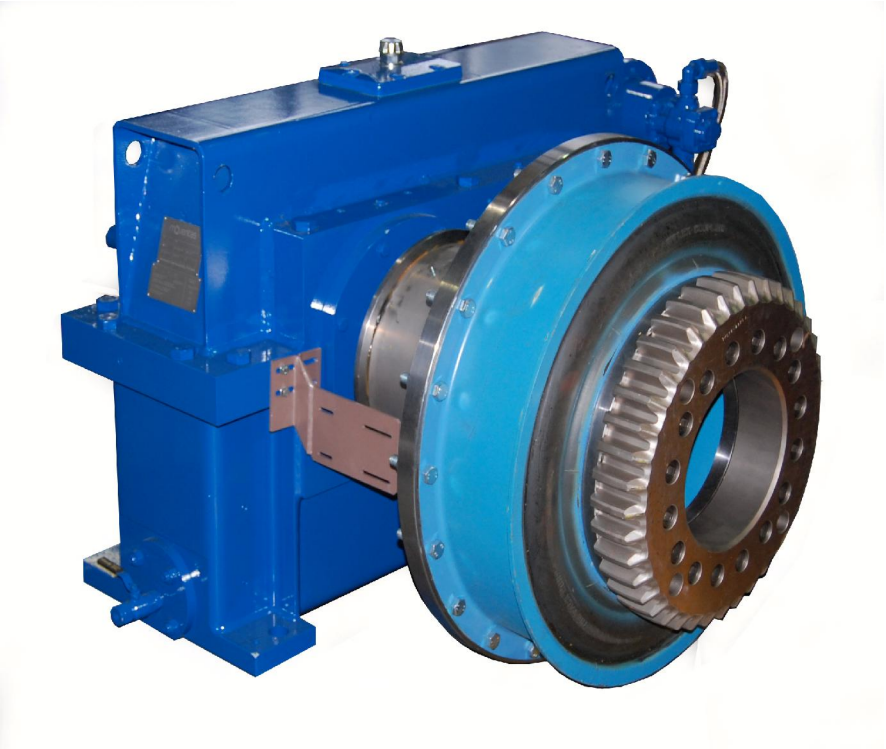
Reel Drives

Opti-reel Secondary Drive

Opti-reel Primary Drive

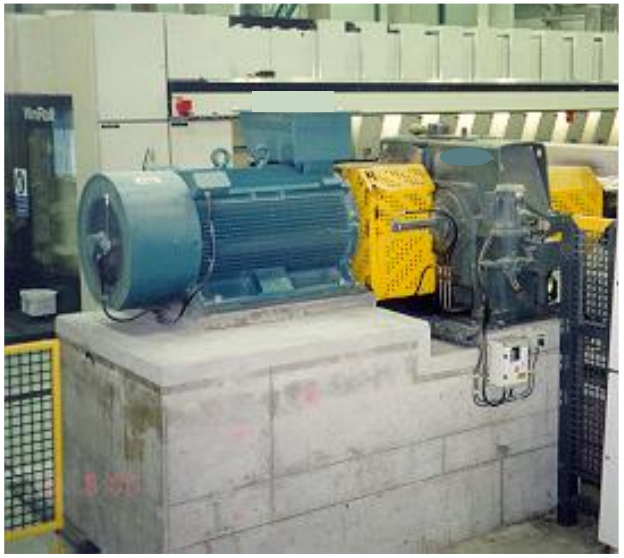
Gear units for OptiReel

- Manufactured since 1995
- Drive solution to both primary and secondary drives of OptiReel-reelers and windup drive of rereeler
- Gear unit is equipped with hydraulically operated secondary coupling
- Safety guard of secondary coupling included
- Gear unit is equipped with pressure lubrication unit



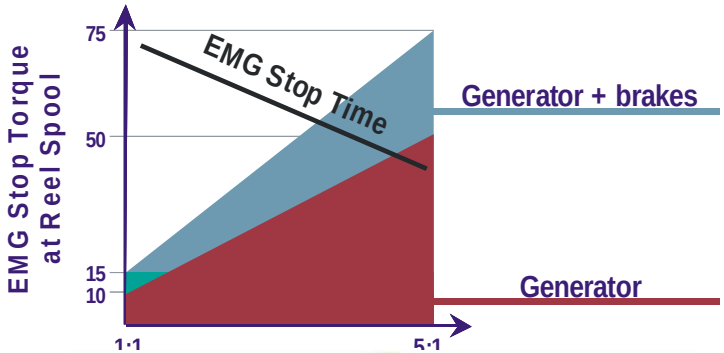
Winder

2X2GL-900-M21

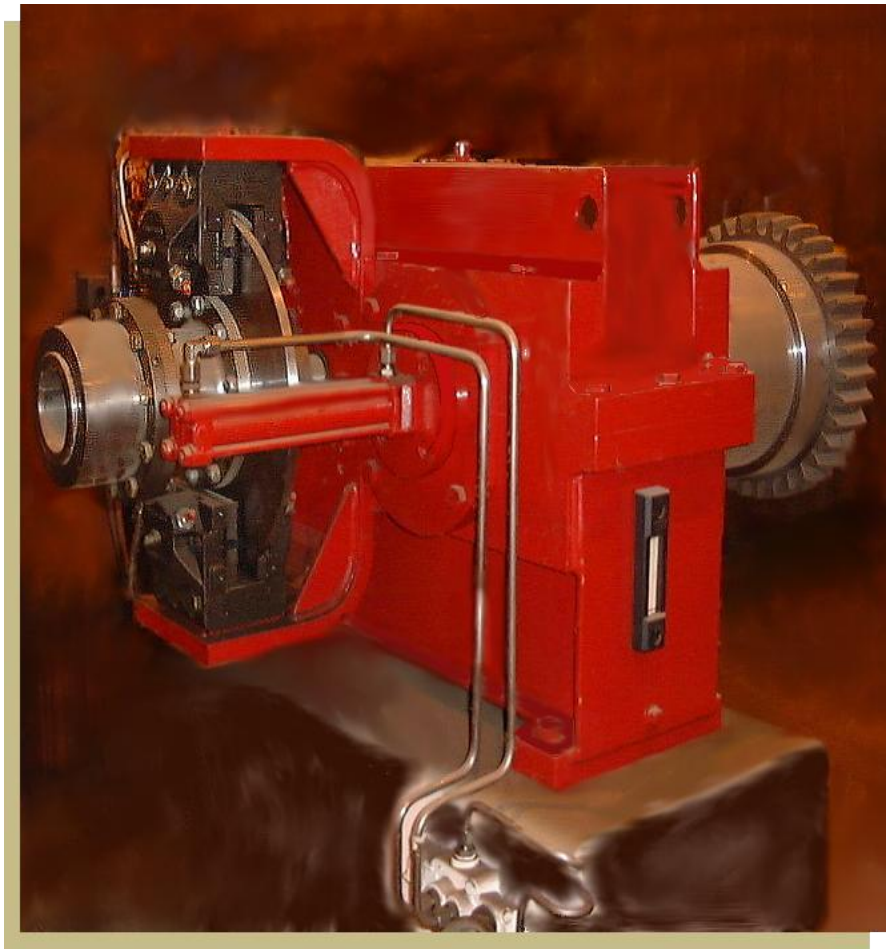


Unwind and windup drive units

- Manufactured since 1988
- Patented drive solution to unwind and windup drives of offline-calenders, winders, rereelers and coating machines
- Gear unit is delivered as a ready-to-install package including:
  - Hydraulically operated secondary coupling which follows oscillating of reel spool
  - To gear unit integrated brake unit including one or two brakes
  - Ready installed piping for the operating cylinder of reel spool coupling and brakes
  - Oil filling filter as standard equipment
  - Safety guards for primary and secondary couplings
- Gear unit can be equipped with separate pressure lubrication unit or connected to central lubrication system of winder



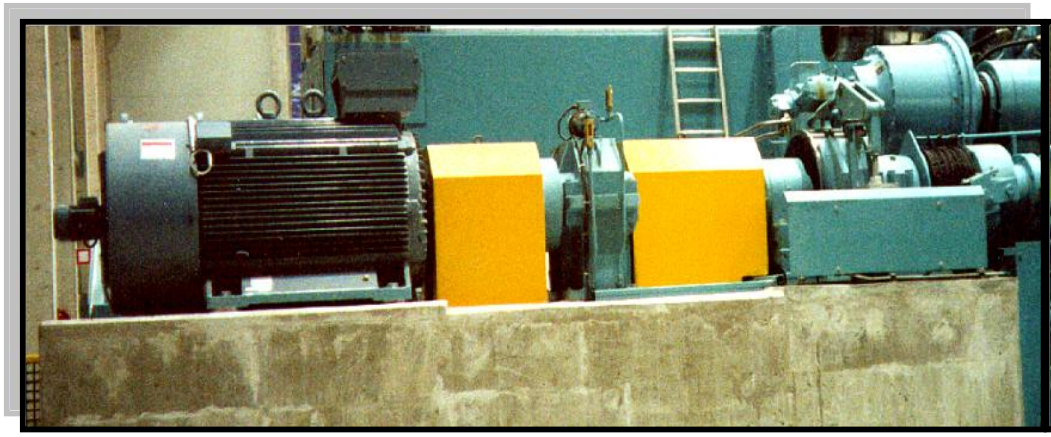
ARDrive Concept

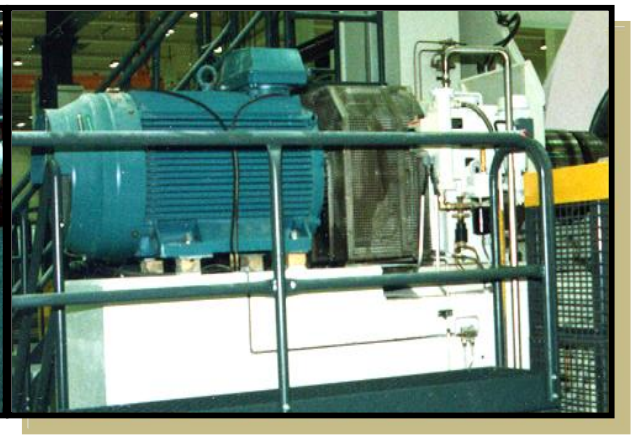


- Precision gear unit
- Integrated disc brakes on the primary side
- Hydraulically operated reel spool coupling
- Pressure lubrication unit
- Customized solutions

ARDrive
Design Advantages

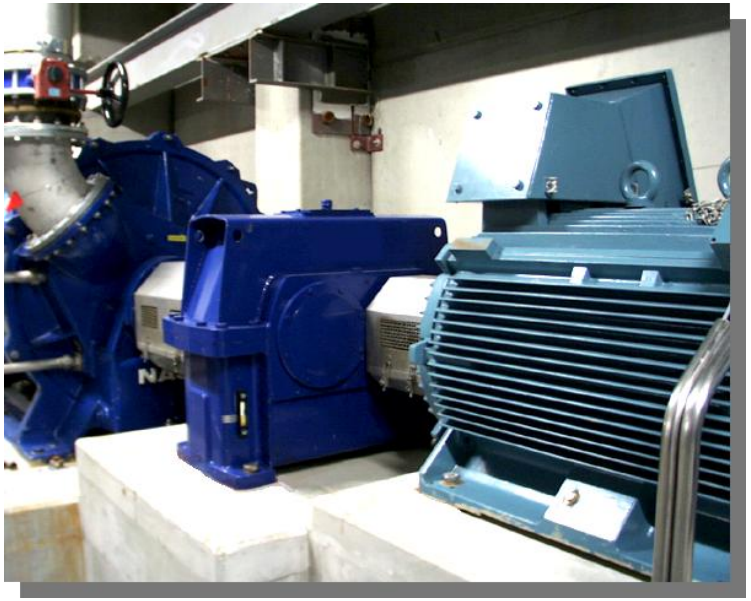
- Lower maintenance costs
- Simple design, easy installation
- Smaller motors & brakes; less space required
- Better control due to higher motor speeds
- Lower investment costs; 30 - 50% savings





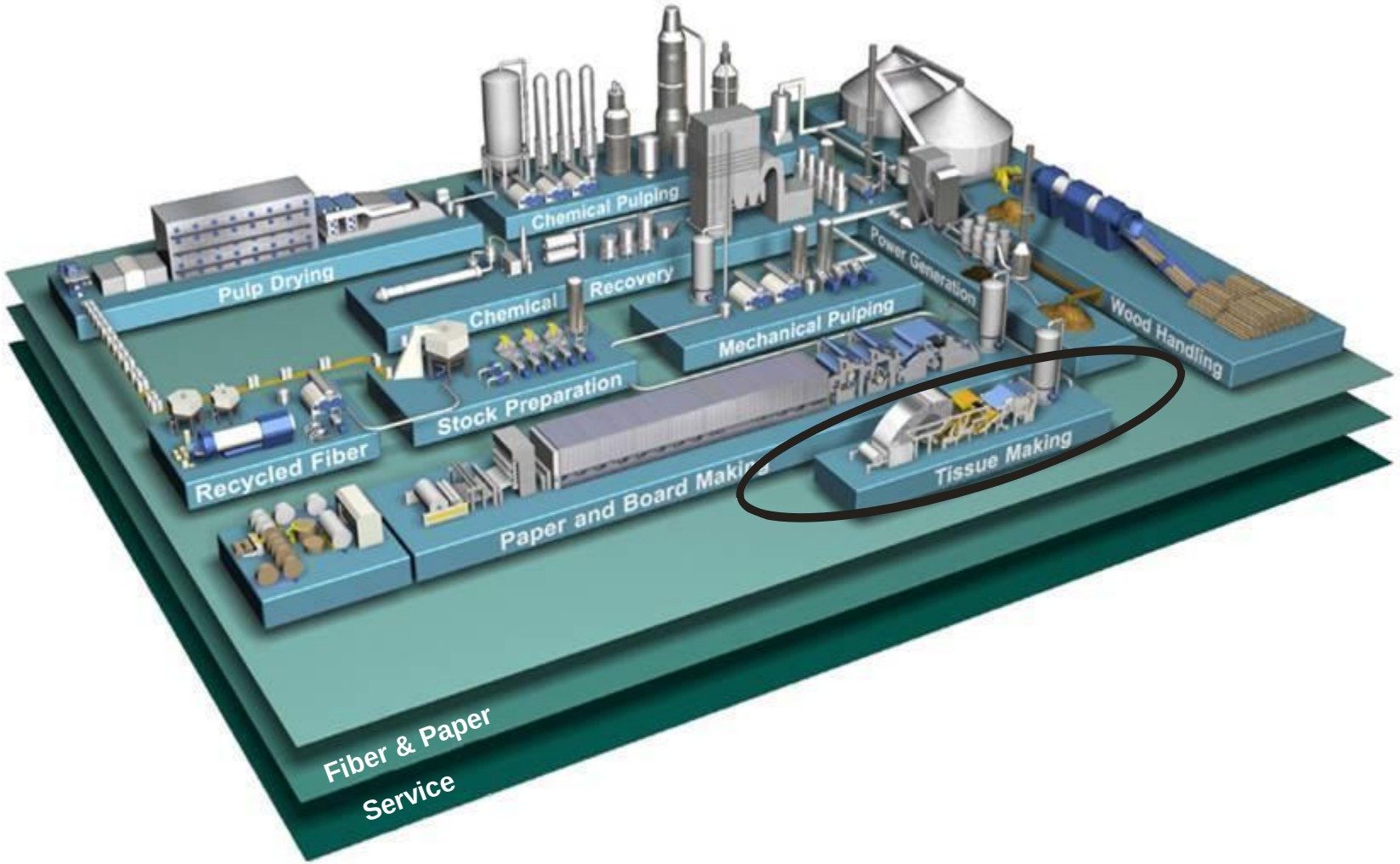
Pump Drives

- Vacuum pumps
- Fan pumps
  - 2-motor drive for high power levels



Vacuum pump drive

Tissue Machine Drives



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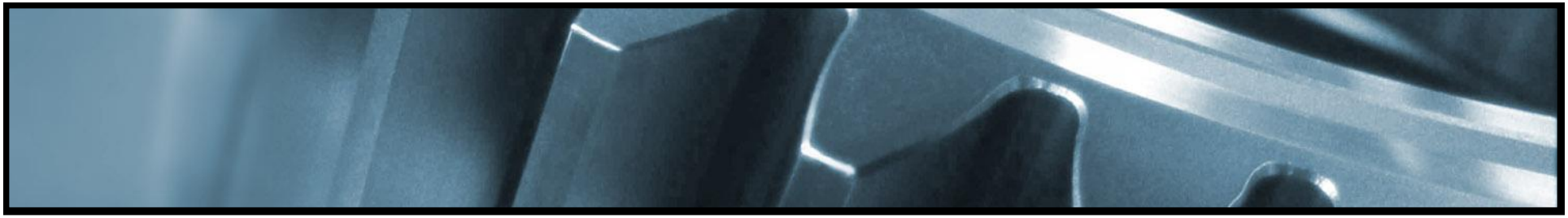
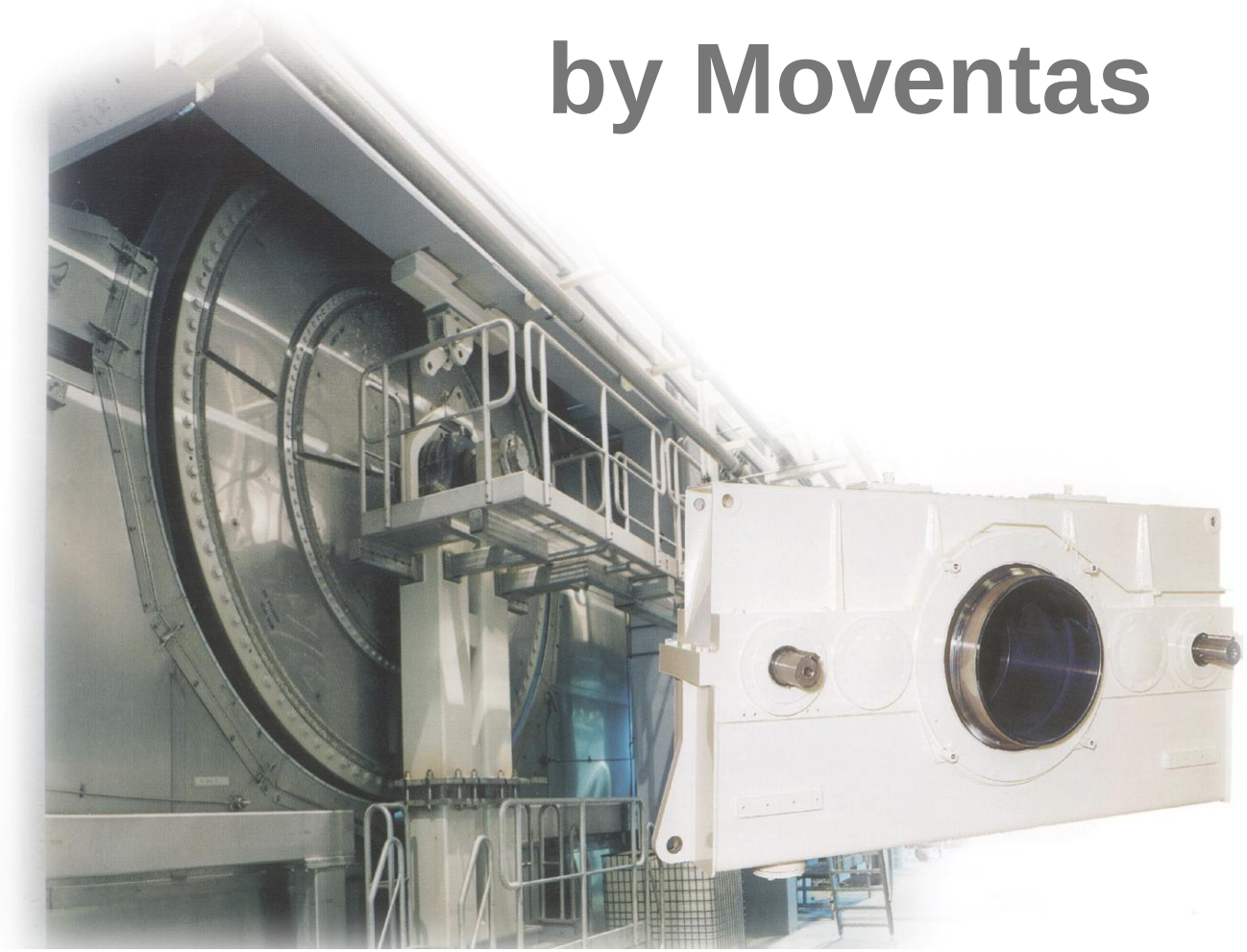


Tissue Machine Drives by Moventas

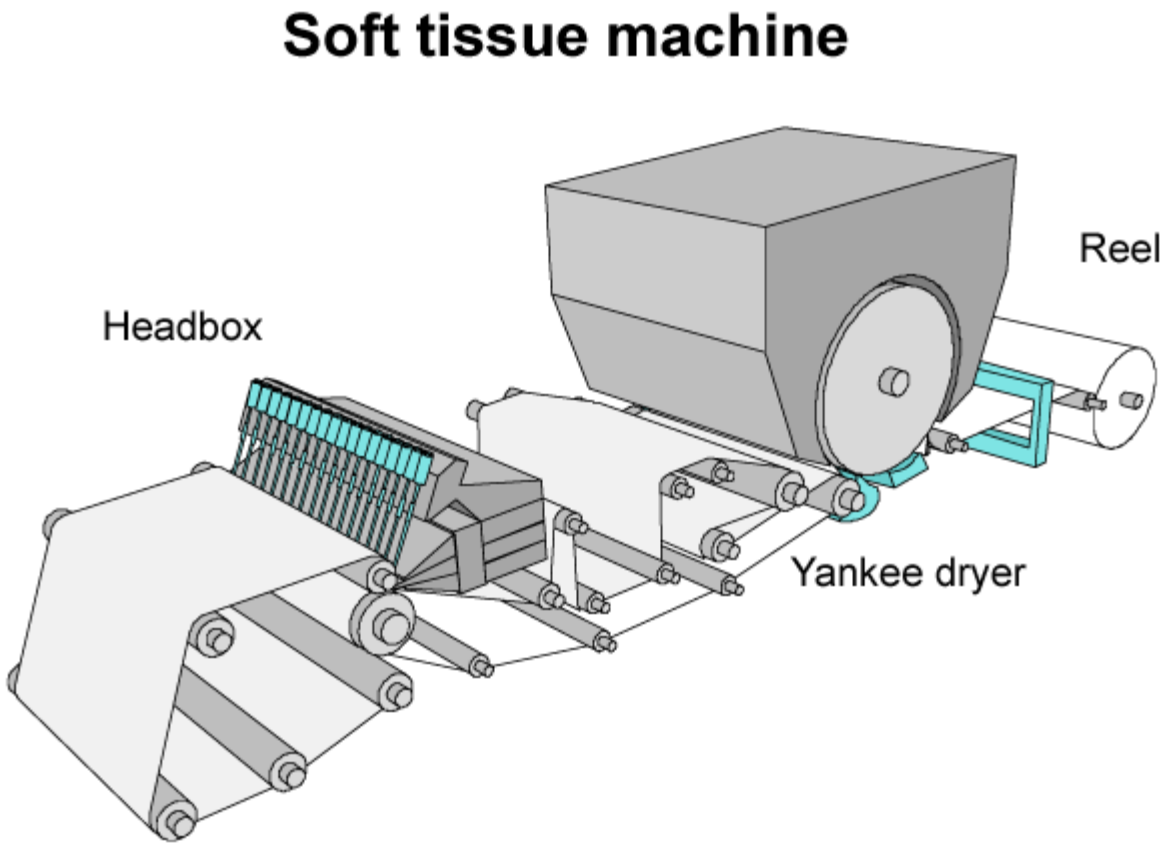


Tissue paper process & drive equipments

- Tissue-paper demand increasing worldwide
- Metso Paper is global market leader as TM OEM
- Andritz, Voith Paper, Toscotec, A Celli, PMT (= ex.Beloit)
- Limited number of global tissue producers:K-C, SCA, Procter&Gamble, Georgia Pacific, Sofidel
- Only 4-10 pcs of driven rolls/ cylinders in a machine
- Special drive units for Yankee cylinders
- TAD cylinder for premium towel quality

Tissue machine layout

§ Typically 4…5 drive points: Former, Suction roll, Yankee, Reel drum

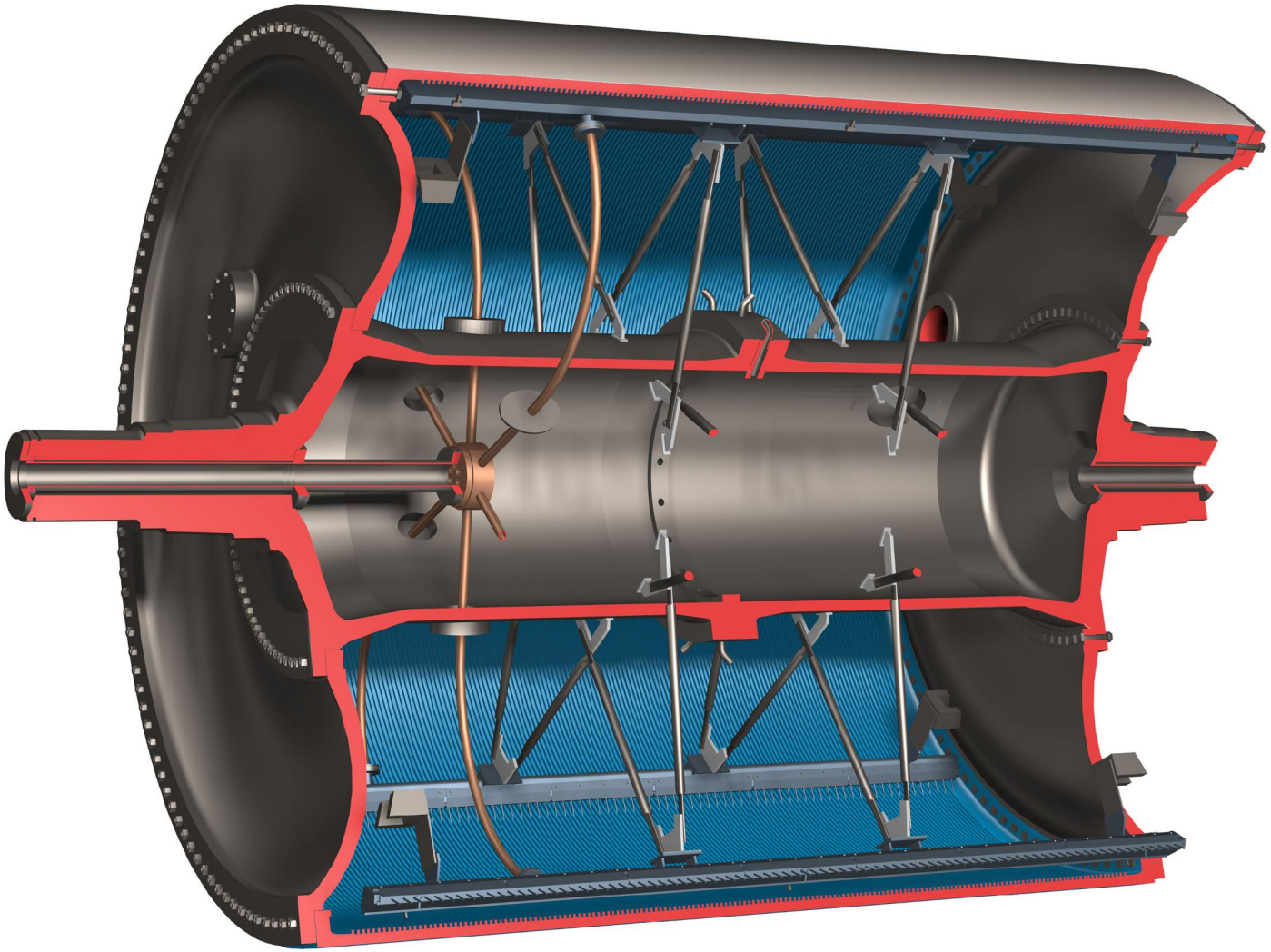


“Periformer Crescent”

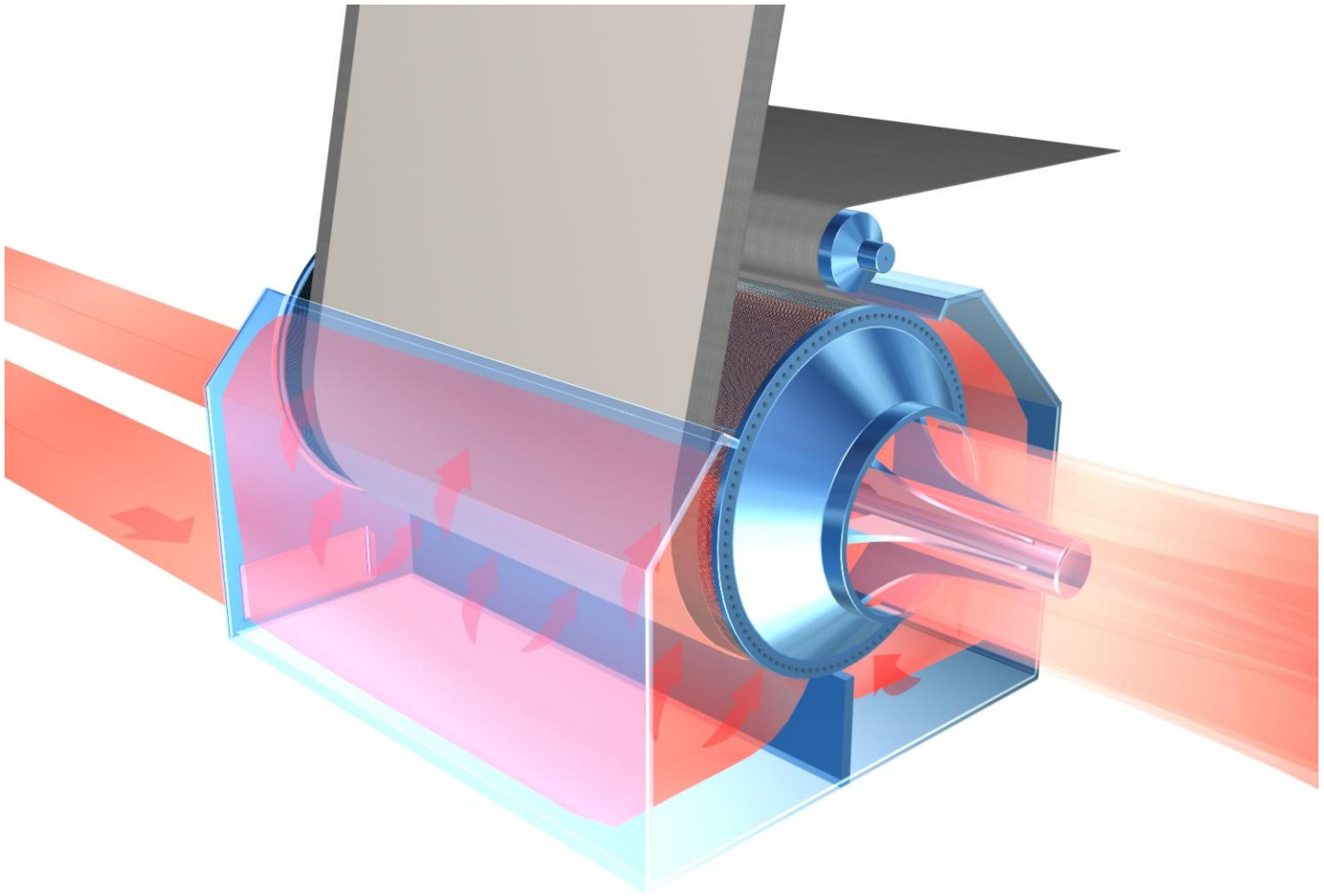
Yankee cylinder dimensions:

- typical diameters 12’(3657mm), 15’(4572), 18’(5486mm)
- typical machine width, 2000…6000mm

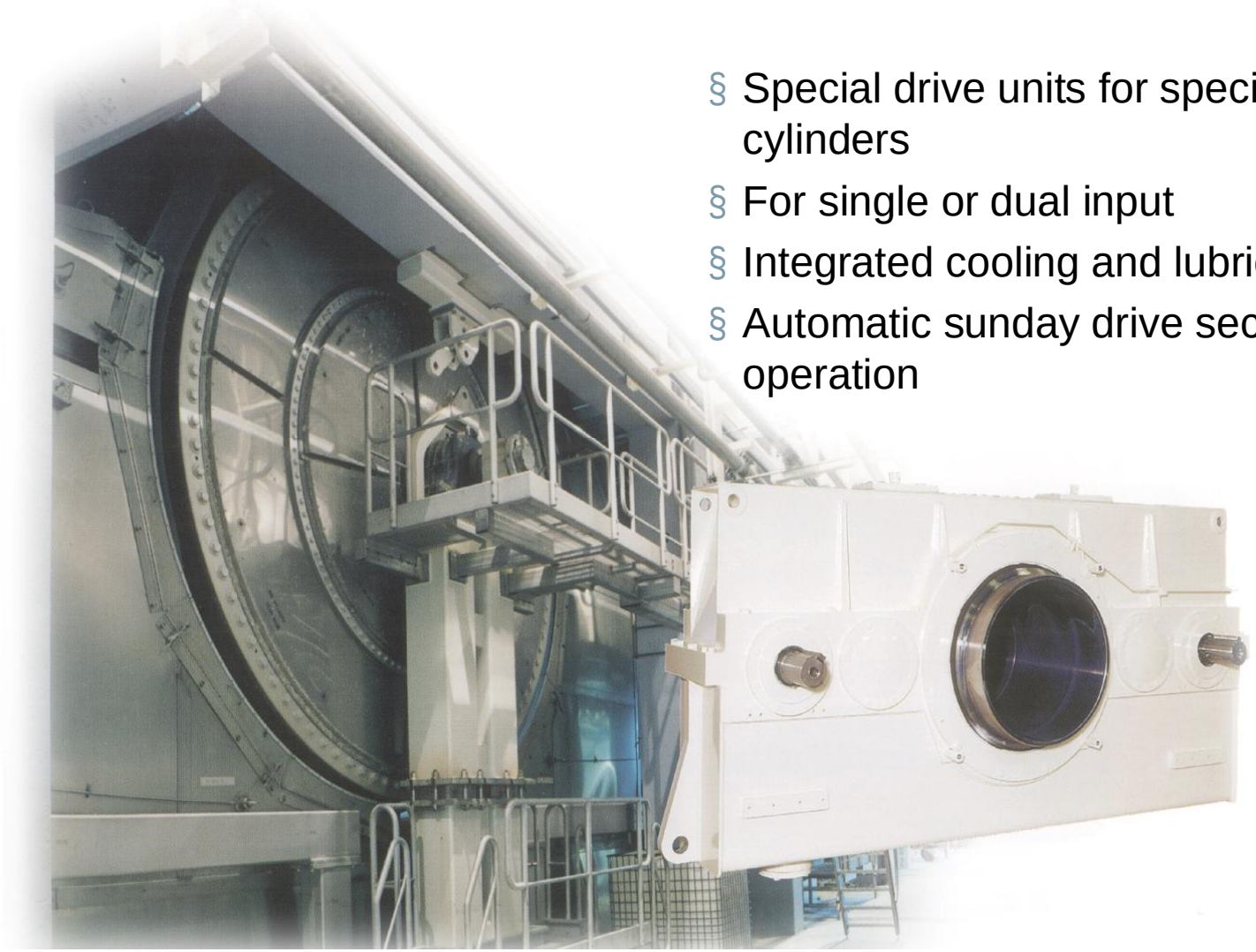
Yankee Cylinder



TAD Principle



Yankee, TAD and MG Cylinder Drives



- Special drive units for special dryer cylinders
- For single or dual input
- Integrated cooling and lubrication units
- Automatic sunday drive secures safe operation

TAD cylinder drives

- Through Air Dryer - hot air is being blown through the paper web
- Premium grade tissue paper drying cylinder, speed 1100 - 2200 m/min
- Cylinder diameter from 1830 to 5500 mm -> gear ratio 7…25:1
- Cylinder shaft diameter 510…590 mm (hollow shaft bore diam.)
- Reducer types used:
  - Double reduction unit S2GH-645, most commonly single input model
- Sunday drive unit S2GW-160 fits for all main drives, gear ratio 101,4:1
- Unit selection dictated by cylinder journal diameter

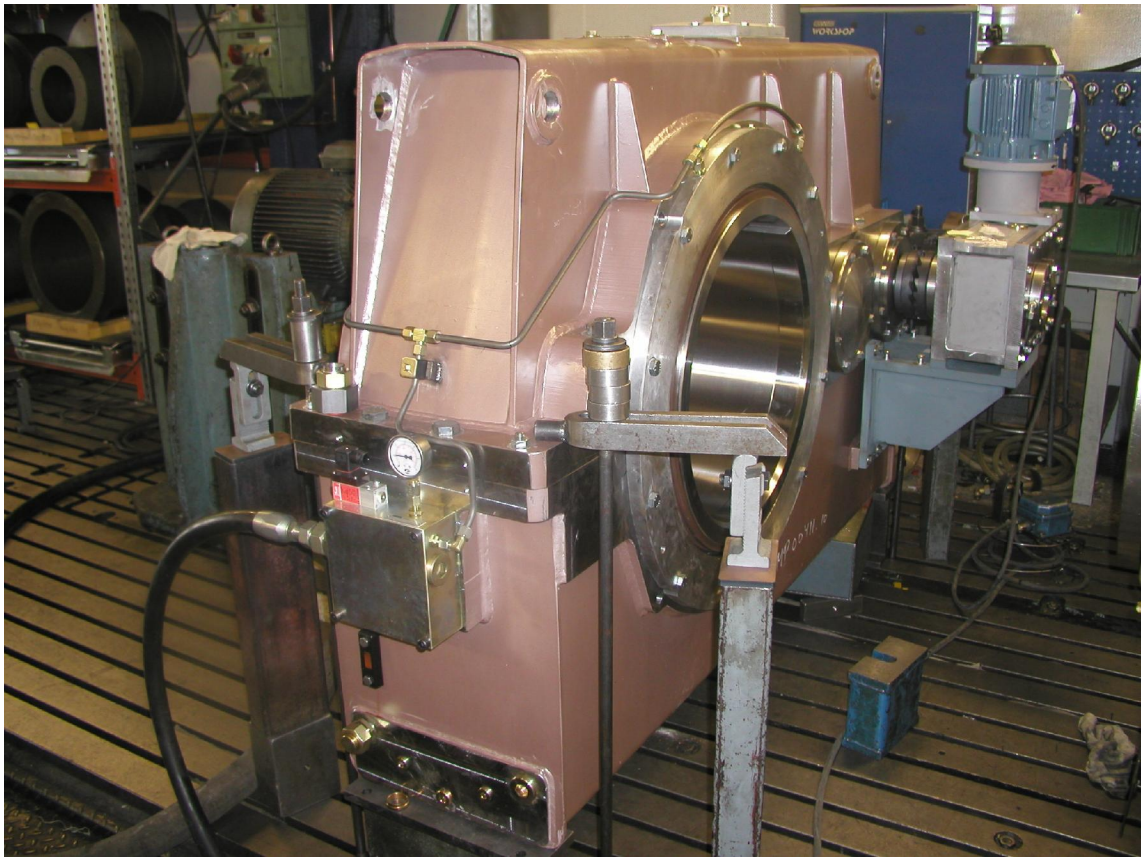
Yankee cylinder drives

- Tissue paper drying cylinder, speed 1100 - 2200 m/min
- Yankee section web speed is lower than TM wire section web speed
- Cylinder diameter from 3600 to 5500 mm -> gear ratio 7…25:1
- Cylinder shaft diameter from 300 to 520 mm (hollow shaft bore diam.)
- Reducer types used (double reduction):
  - S2GH-450 and S2GH-645, single or twin input (2x) models
  - 2TMG450, 2TMG500 and 2TMG560, single or twin input (2D) models
  - special small unit S2GH-360 used in pilot machines and small TM rebuilds
- Sunday drive unit S2GW-160 fits for all main drives, gear ratio 101,4:1
- Unit selection decided by cylinder journal diameter, input mode and...
- Customer preference (preferred supplier eg. Santasalo/Valmet)

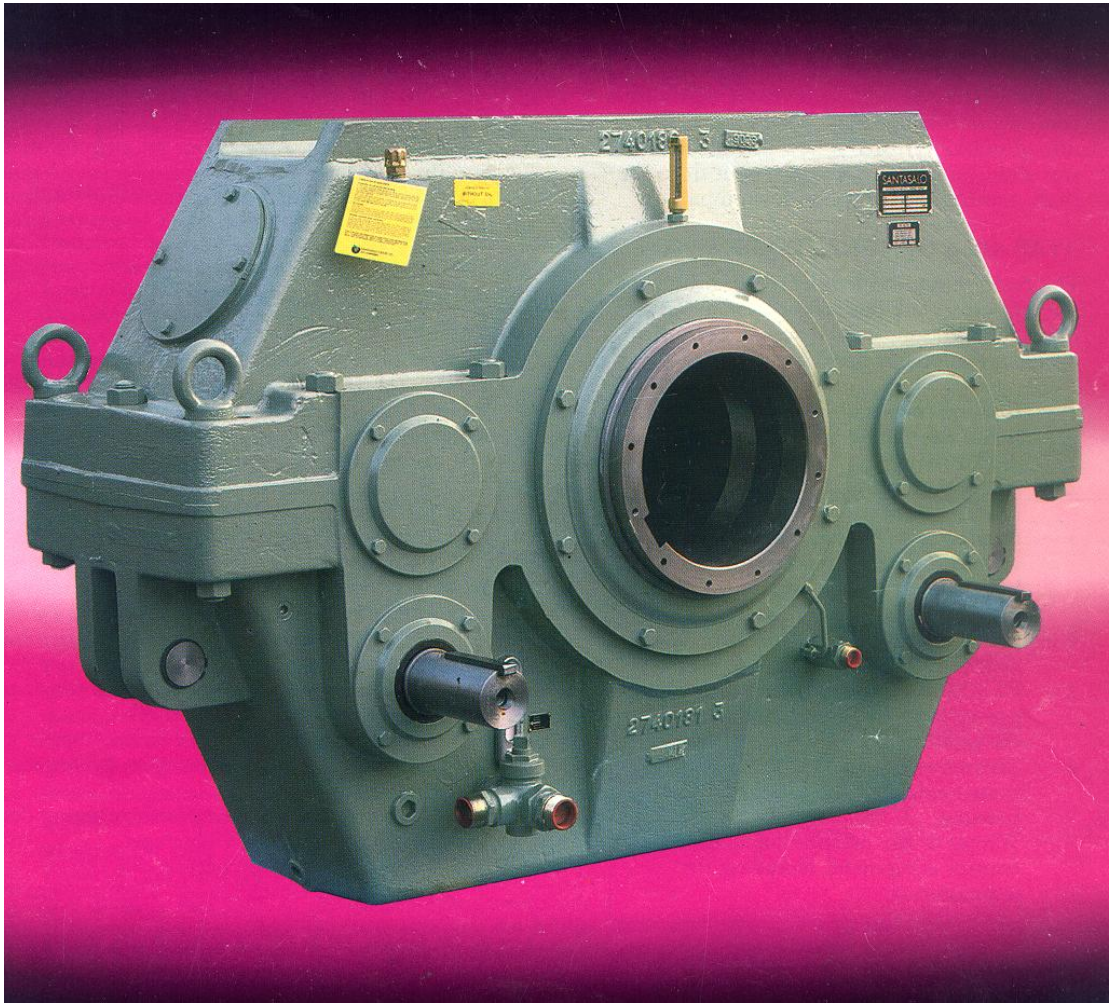
MG cylinder drives

- Board drying/finishing cylinder, BM speed typically low
- MG-cylinder peripheral speed is higher than BM web speed
- Cylinder diameter from 3660 to 5500 mm -> triple reduction unit
- Cylinder shaft diameter from 300 to 520 mm (hollow shaft bore diam.)
- Reducer types used:
  - Triple reduction S3GH-645, single or twin input model
  - Triple reduction 3TMG450, 3TMG500 and 3TMG560, single input models
- Sunday drive unit S2GW-160 fits for all main drives, gear ratio 101,4:1

TAD-cylinder drive unit - S2GH-645 equipped with Sunday drive unit S2GW-160



Yankee cylinder drive unit - 2D2TMG560



Pulp Drying Machine Drives