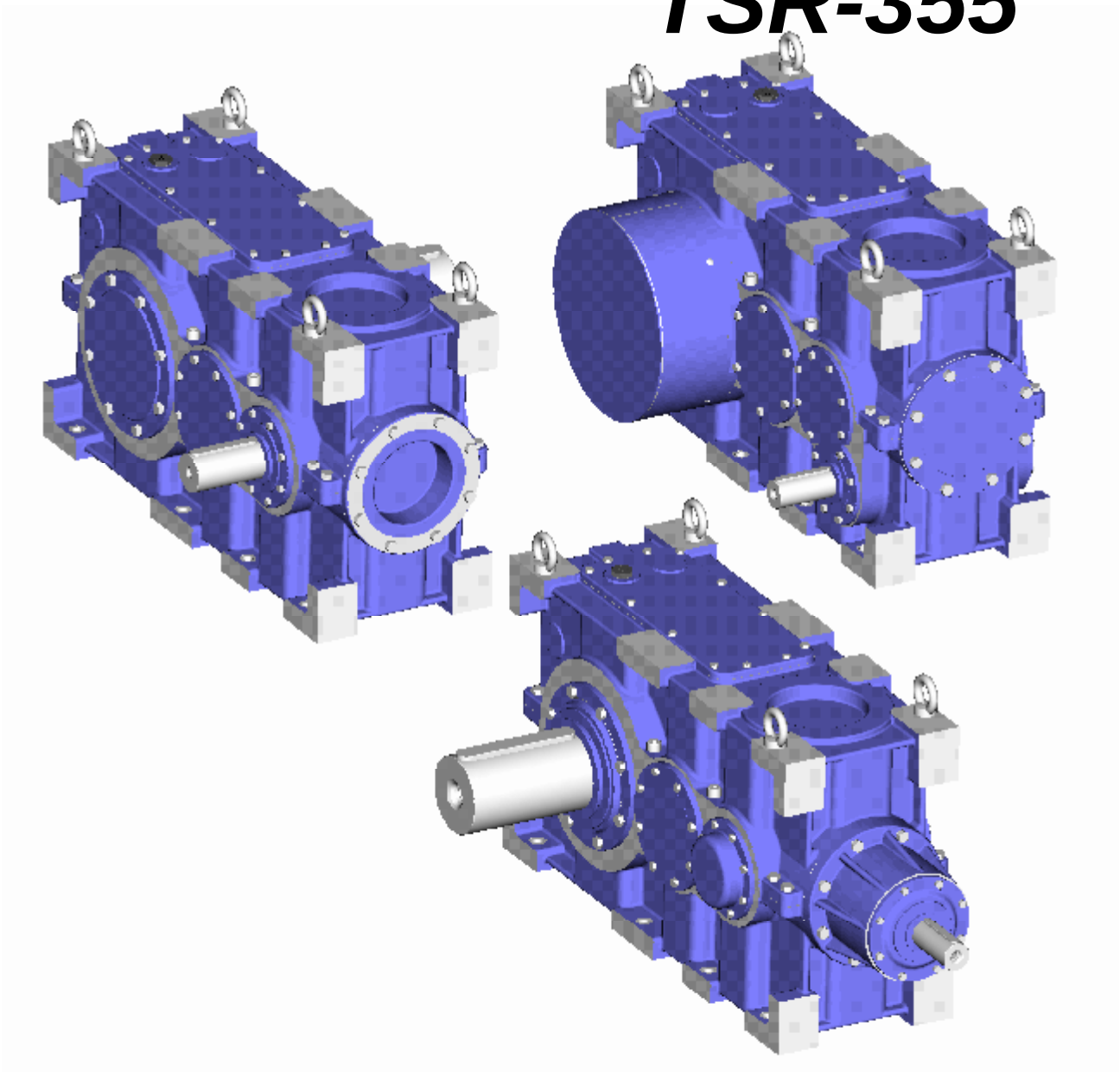
SPUR GEARBOXES TSP-355

GEARBOXES WITH BEVEL & SPUR GEARS TSR-355



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Ladies and Gentlemen,

this trade catalogue that is submitted to technical community presents long-term experience within the field of manufacture and application of driving gears.

Throughout the last four year, our team of specialists collected specific requirements, advices and recommendations of our customers that resulted in balanced product line being submitted. We believe that this product line will be applied in our present and also future partnership and cooperation.

First of all, let us provide you some basic information about our company.

ZTS Sabinov is a joint-stock company operating within engineering industry, established in 1957. The production of gearboxes comprises majority of production. Currently, ZTS Sabinov produces the following gearbox types:

spur
bevel
bevel and spur
worm
planetary

Gearboxes are produced in series as standard types with wide range of use in different industry branches. Besides them, ZTS Sabinov produces gearboxes for different applications that can be divided in following groups:

- § gearboxes for truck mounted and stationary concrete mixers
- § gearboxes for mining conveyers
- § gearboxes for cooling towers
- § gearboxes for mobile construction vehicles
- § gearboxes – winches designed for lifting wagon platforms in railway transport
- § other

A large group consists also of gearboxes projected and produced based on customers' specifications or customer drawings.

Export territories and applications

Our products are exported to USA, Germany, Czech Republic, Great Britain, Ireland, Netherlands, Poland, countries of former Soviet Union, Hungary, Spain, Italy, Egypt, Syrian Arab Republic, India, United Arab Emirates, Taiwan, Thailand etc.

Our gearboxes are exported indirectly, as well, i.e. by suppliers of investment gross (technologies) as sugar – refineries, metalurgical plants, cement & calc producing plants, brickyards, power stations etc. and also as parts of final devices used in enterprises referred to.

Quality

In 1997, we implemented quality management system according to EN ISO 9001 regulation that we use in practice and we have held envirocertificate EN14001 since 2003, as well.

Basic contact information

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1. INTRODUCTION

The trade catalogue covers:
Double reduction spur gearboxes TSP2:

- § with axial distance of output node a=355
- § with range of gears: 5 to 31,5
- § with power range: 102 to 1039kW.

Triple reduction spur gearboxes TSP3:

- § with axial distance of output node a=355
- § with range of gears: 20 to 125
- § with power range: 34 to 464kW.

Triple reduction bevel and spur gearboxes TSR3:

- § with axial distance of output node a=355
- § with range of gears: 20 from 20 up to 125
- § with power range: 34 to 470kW.

The gearboxes are available in two basic versions:

- **a.** with solid output shaft.
- **b.** with hollow output shaft and:
  - cone shaft clamping element at output
  - cylindrical hole with groove
  - conical hole with groove
  - cylindrical hole and involute grooving

The design of gearboxes is adapted to heavy working conditions and explosive environment (as in mining industry) and the body moulds and housing cover, heat-treated shafts and gearing, bearings and labyrinth seals combined with rubber seals supplied by reputable companies meet that.

Bevel gearing is cemented and hardened. Spur gearing is cemented, hardened and ground. Body and cover of the housing are moulds. Moulds are made with coarseness Rz=100, what allows simple cleaning of housing surface. Lubrication of gearboxes is secured by splash from gearwheels. Gearboxes may be cooled by heat sink via gearbox housing walls or supplementary cooling, as the case may be.

If gearboxes are used for conveyor drives working under certain slope, one-way clutch that avoids reverse of gearboxes may be inserted to gearbox structure.

All gearboxes may be equipped with special accessories:

– <u>Cooling – depends on loads transmitted</u>:

- § **cooling via fan on input shaft**
  - fan allows better air circulation around the gearbox, whereby it improves heat transfer through gearbox walls
- § **oil cooling via water cooling embedded in gearbox**
  - in such case, gearboxes are equipped with rolled cooling pipes that serve for supply and drain of cooling water
- § **oil cooling by external circuit - external cooler**
  - warm oil is pumped from gearbox to cooler, where the temperature drops down and cold oild is pumped through back to gearbox

***- <u>Oil preheating</u>* -** at ambient temperatures below + 5 ^{o}C it provides for a friendly gearbox startup,

- <u>Device guarding against reverse of gearbox</u> (interlocking device),

***- <u>Gearbox monitoring</u>*.**

In order to secure gearbox operation monitoring, gearboxes may be supplied with holes (made according to customer requirements) for connection of:

- § oil flow indication,
- § vibration sensor,
- § housing temperature sensor,
- § oil temperature sensor,

- <u>Special requirements</u>

Based on special requirements, gearboxes may be supplied according to requirement with a possibility of:

- § other surface treatment than referred to in point 5. Delivery,
- § input and output shaft according to customer's requirement.
- § possibility to connect torque catcher

2. GEARBOX TYPES

Chart no. 1

VERSION	DENOMINATION
§ with solid output shaft	TS... – 355 - J
§ with hollow output shaft and cone shaft clamping element	TS... – 355 - DS

3. GEARBOX EFFICIENCY

Chart no. 2

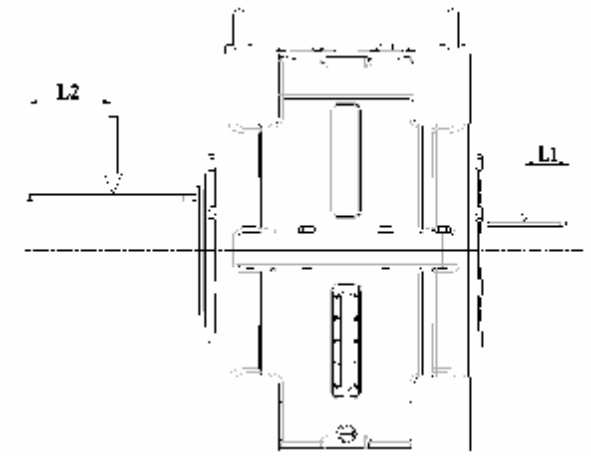
GEARBOX TYPES	EFFICIENCY
Double reduction spur gearbox	**0,975**
Triple reduction spur gearbox Triple reduction bevel and spur gearbox	**0,965**

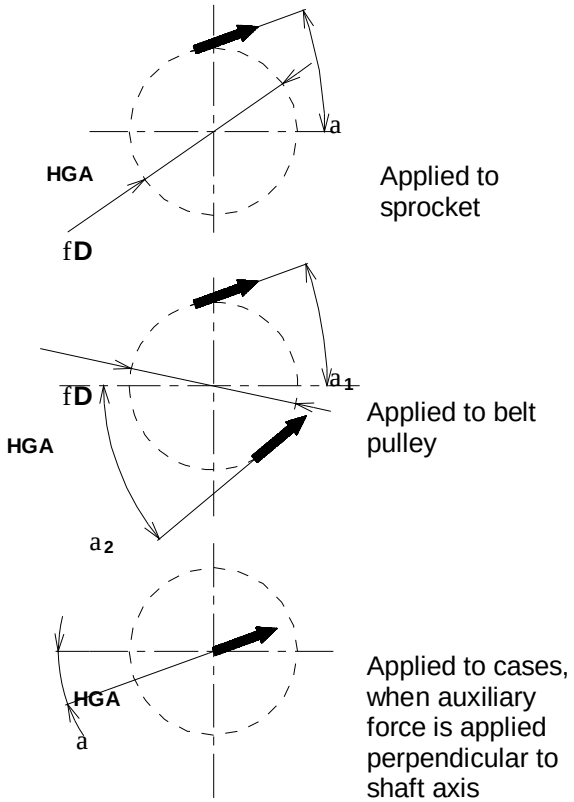
4. ADDITIONAL LOAD OF INPUT AND OUTPUT SHAFT

TSR, TSP gearboxes are calculated without considering additional forces acting on input and output shaft. These have effect especially on lifespan of bearings on these shafts, namely depending on size, direction and centre of these forces. Therefore, if it is necessary to take additional forces on these shafts (e.g. if belt pulleys are used) in account, such situation is to be consulted with manufacturer of gearboxes. Data according to Fig. 1 are necessary for exact determination of effect of additional forces.

Scheme no. 1

HGA – horizontal gearbox axis





5. DELIVERY

Gearboxes are mounted according to trade catalogues. They are delivered as stored on wooden europalletes.

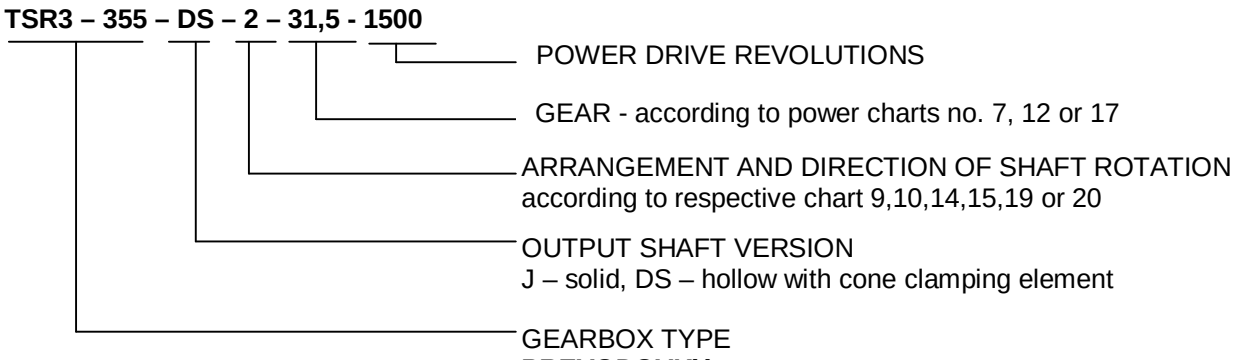
Gearboxes may operate in dusty, humid and chemically unobjectionable environment, which does not deteriorate oil filling and does not reduce sealing capacity of rotary sealing.

Gearbox housing is split, whereas interface surfaces are caulked by sealing putty. Inner housing walls are coated with oil-resistant colour. Outer housing walls are coated with synthetic paint by default.

Gearbox is supplied fully assembled without connecting screws and oil filling. Interior of gearbox housing is preserved using conservation oil. Warranty period for preservation of internal parts of gearbox is 12 months.

6. ORDERING

Denomination of gearbox in order is according to following example:



Prior to ordering a gearbox, it is advisable to fill in „technical form to gearbox design“ that is an annex to this catalogue and send it to TSR, TSP gearbox manufacturer in order to consult suitability of gearbox selection.

7. SELECTION OF GEARBOX

High operating safety and required lifespan of selected gearbox may be achieved only if all effects, to which gearbox is faced to during its operation are taken in account at selection of gearbox.

At selection of gearbox, it is necessary to proceed according to example in chapter 7.5. Coefficients in chapters 7.1 to 7.4 take in account deviations from calculation state.

7.1 Operational coefficient - k_1

Both TSP and TSR gearboxes are designed for 8 hours non-stop and non-beat daily operation. The k_1 coefficient (from Chart no. 3) takes in account gearbox load deviations from this calculation state.

Chart no. 3

Prime mover type	Net daily operation time	Prime mover type according to Chart no. 7		
		I	II	III
Electromotor, turbine	Up to 8 hrs	1	1,2	1,3
	8 to 12 hrs	1,1	1,3	1,4
	12 to 24 hrs	1,3	1,5	1,7
Combustion 4 to 6 cylinder engine, hydraulic motor	Up to 8 hrs	1,15	1,35	1,4
	8 to 12 hrs	1,25	1,5	1,6
	12 to 24 hrs	1,5	1,8	2,0
Combustion 1 to 3 cylinder engine	Up to 8 hrs	1,25	1,5	1,75
	8 to 12 hrs	1,4	1,7	2
	12 to 24 hrs	1,75	2,1	2,45

Machines and equipment corresponding to symbols I, II, III – from Chart no. 6 on page 7, 8, 9.

7.2 Coefficient of startup count - k_2

The k_2 coefficient (from Chart no. 4) takes in account effect of starting torque on lifespan of gearbox.

Chart no. 4

Startup count per hour	Operational coefficient k_1				
	1	1,15 – 1,25	1,4 – 1,5	1,6 – 1,75	2 and more
1	1,0	1,0	1,0	1,0	1,0
2 – 40	1,1	1,08	1,07	1,06	1,06
41 – 80	1,4	1,3	1,23	1,18	1,1
81 – 160	1,6	1,5	1,35	1,23	1,1
Over 160	1,8	1,7	1,5	1,3	1,1

7.3 Heat coefficients - k_{cw1}, k_{cw2}, k_{cw3} for gearbox selection

The k_{cw} coefficients (from Chart no. 5) are used for determination of heat output and cooling method.

Chart no. 5

Net operation time per hour * [%]	WITHOUT COOLING k_{cw1} Ambient temperature					FAN COOLING k_{cw2} Ambient temperature					EMBEDDED COOLING k_{cw3} Ambient temperature				
	10°C	20°C	30°C	40°C	50°C	10°C	20°C	30°C	40°C	50°C	10°C	20°C	30°C	40°C	50°C
100%	1,15	1,0	0,9	0,7	0,6	1,1	1,0	0,9	0,8	0,6	1,15	1,0	0,9	0,8	0,7
80%	1,35	1,2	1,05	0,9	0,7	1,2	1,2	1,0	0,9	0,7	1,35	1,2	1,1	1,0	0,8
60%	1,5	1,4	1,2	1,0	0,8	1,3	1,4	1,2	1,1	0,8	1,6	1,4	1,3	1,1	0,9
40%	1,7	1,6	1,4	1,1	1,0	1,8	1,6	1,4	1,2	1,0	1,8	1,6	1,5	1,3	1,1
20%	2,0	1,8	1,5	1,3	1,1	2,0	1,8	1,7	1,4	1,1	2,0	1,8	1,65	1,45	1,2

* Net operation time per hour indicates the percentage of one hour, during which a gearbox is in operation. If it works over one hour without interruption, 100 per cent is referred to.

7.4 Determination of starting torque

Maximum locked-rotor torque of motor may not exceed rated torque of gearbox on input shaft of gearbox multiplied by 1,8.

If power drive does not meet this condition, it may be achieved in operation e.g. by controlled start of powertrain (double reduction motors, frequency converter etc.), using a clutch with soft characteristics. It is not recommended to use drive with asynchronous motor and short-circuit armature, controlled via direct connection to power supply (stator winding is connected to a triangle).

Examples of machines and devices corresponding to symbols I, II, III – from Chart no. 3

Pottery	
Pug mill	II
Clay mill	II
Clay presses	III
Blowers	
Hand blowers	I
Blowers with rotary cylinders	II
Centrifugal blowers	II
Suction blowers	II
Cranes, jacks	
Tower gantries	III
Fork-lift trucks	II
Cranes and jacks:	
- for heavy lifting	III
- for medium-weight lifting	II
Mining industry	
Gritters for bank	II
Mining grinders	III
Briquetting presses	III
Pulley blocks	III
Hoisting machines	III
Belt conveyors	III
Mining fans	III
Generators	
Constant load generators	I
Welding generators (alternators)	III
Excavators	
Belt excavators with conveyor	II
Chain bucket-wheel excavator	III
Wire pulley block excavators	II
Servicing hoists	II
Suction pumps	III
Workbench power drives	III
Wheel bucket-wheel excavator	II
Grinders	
Mineral crusher	III
Stone crusher	III

Chipless-machining metal-working machines	
Seamers	III
Benders and flatteners	III
Drawing benches for manufacture of wires	III
Eccentric presses	III
Drop-presses	III
Punching presses	II
Riveting machine	III
Pipe presses	III
Forging presses	III
Wire- and bar drawers	III
Control mechanismes	II
Mixers	
Continuous movement concrete mixers	II
Intermittent movement concrete mixers	I
Mixers for various consistency and stable composition liquids	II
Mixers for persistent consistency liquids	I
Stirrers	
Stirrers for liquids containing solid particles	II
Stirrers for clear liquids	I
Mills	
Rotary mills	II
Disk masticators	III
Ball mills	III
Drum cleaners	III
Swing-hammer mills	III
Drum mills	III
Drum and bar mills	III
Ship power drives	
Main ship power drives	II
Auxiliary ship power drives	II
Machining devices	
Main power drives	II
Auxiliary power drives	II
Woodworking machines /general/	II

Examples of machines and devices corresponding to symbols I, II, III – from Chart no. 3

Chart no. 6 - cont.

Pumps	
2-cylinder piston pumps with double effect	III
3 and more cylinder piston pumps	II
Immersion pumps	III
Centrifugal and gear-type pumps for liquids with appropriate consistency	II
Centrifugal and gear-type pumps for liquids with various consistency	II
Light dosing pumps	II
Heavy dosing pumps	III
Rotary furnaces	II
Conveyors	
Bucket-wheel conveyors with high load	II
Conveyors, feeders	
Belt conveyors	II
Conveyors – production belts	II
Conveyors with normal load	I
Conveyors with high load	III
Conveyors with uneven load	III
Forward - reverse motion conveyors	III
Suspended cableway	II
Apron conveyors	II
Belt vibrating conveyors	III
Belt conveyors with even work	II
Rubber industry	
Rubber rolling machines	III
Rubber mills	III
Stirrers	III
Plate machines	II
Screening machines	II
Metallurgical industry	
Blast-furnace blowers	II
Converters	III
Slag crusher	III
Inclined hoists of blast-furnaces	III
Slag mills	III
Continuous casting devices	III
Oil refining industry	
Presses for paraffin filtration	II
Pumps for oil pipelines	II
Treating machines	II
Drilling cranes for rotary drilling	III
Paper industry	
Belt conveyors	I
Bleaching machines	I
Spinning machines	II
Spinners and intake cylinders	III
Glazed cylinders	III
Beaters	II
Whetstones	III
Rolling machines	III
Wet presses	III
Stirrers	II
Drying cylinders	III
Upsetting devices and thickeners	II
Textile industry	
Grinding machines	II
Dyeing machines	II
Fillers	II
Carding machines	II
Willowing machines	II
Annular spinning machines	II
Soaping machines	II
Frame expansion machines	II
Fine spinning machines	II
Sleeve-type drying chambers	II
Sieves	
Flat sieves	II
Sieves for air scrubbers	I
Sieves with moving water inlet	I
Wire screens for stones and sand	II
Compressors	
Compressors with rotary piston	II
Piston-type compressors (multi-cylinder)	II
2-cylinder piston-type compressors	III
Single-cylinder piston-type compressors	III
Gears	
Light gears	I
Gears for power drives of machine tools	II

Examples of machines and devices corresponding to symbols I, II, III – from Chart no. 3

Conveying equipment	
Wagon tipplers	III
Wagon pullers	II
Rolling mills	
Main power drives	
Rolling lines for slab bloom and blocks	*
Thin sheet rolling lines for hot-rolled sheet metal	III
Rolling lines for thin bars and wires	III
Rolling lines for thick sheets and wide tapes	III
cold-rolling	*
Rolling lines for crowbars and sheet metal	
Rolling mills for wheel tyres and plies	III
Rolling lines for heavy profiles and gross rolling	*
Rolling lines for flat steel and medium bars	*
Auxiliary equipment	
Sheet-doubling machines	III
Reverse mechanismes	III
Wire reeling device	III
Turnings remover	III
Shears for billets and warped castings for sheet metal	*
Crank shears	*
Cooling benches	II
Rotary shears or trimming shears	III
Straightening presses	*
Roller straighteners	III
Pulling devices	II
Cold- and hot saws	III
Devices for disassembly of cylinders	II
Auxiliary power drives	
Sliding devices	*
Working and feeding tension devices	III
Slab-type lifters and hoist benches	III
Roller conveyors	III
Tube rolling mills	
Rolling mills for cold calibration	III
Pilgrim rolling mills	*
Reduction calibrating tube rolling mills	III
Die hammers and flatteners	III
Rolling and finishing machines for tubes	III
Tube welding machines	III
Rolling mills with skew cylinders	*
Triblet rolling mills	*
Expansion rolling mills	III
Centrifuges	
Light centrifuges	II
Heavy centrifuges	III

*Industrial machines, in case of which, special conditions must be taken in account. Used motion coefficients are test values for normal operating conditions.

7.5 Example of selection of gearboxes

7.5.1 Input data

- Prime mover: – electromotor: P_e = 200kW, n_1=1500 rpm
- Driven machine:
  - – mining conveyor,
  - – work type: III,
  - – power utilized: P_v = 180kW,
  - – necessary output revolutions of gearbox: n_{output}=59 rpm,
  - – net operation time of gearbox: 19 hours per day
  - – net operation time per hour in %: 80%
  - – startup count per hour: 10 startups per hour
  - – ambient temperature: 30 ^oC
- Gearbox type – triple reduction spur gearbox laid on the floor without an option of bottom cooling

7.5.2 Basic calculation

Required gear: $i = n_1/n_{output}$=25,42
Selected closest gear: i = 25
Required gearbox power: $\mathbf{P_{1N} = P_V \times k_1 \times k_2}$ = 180 x 1,7 x 1,06 = 324,36kW
Selected gearbox type: TSP3-355 with i = 25 and P_1 = 373 kW at 1500 rpm

P_{1N} – calculated necessary gearbox power [kW]
P_1 – catalogue gearbox power [kW]
P_e – electromotor power [kW]
P_v – utilized power of electromotor [kW]
n_1 – input revolutions to gearbox [ot/min]
k_1 – operating coefficient – Chart no. 3
k_2 – startup count coefficient – Chart no. 4

7.5.3 Inspection of gearbox for heat output P_t

P_{t1} = 160kW – heat output according to Chart no. 13
k_{cw1}= 1,05 – according to Chart no. 5
$\mathbf{P_t = P_{t1} \times k_{cw1}}$ = 160 x 1,05 = 168kW – maximum power that can be transmitted via gearbox without cooling.
$P_t < P_V$ (168 < 180) kW
This data indicates that cooling is necessary. We will carry on with inspection of heat output for fan cooling.
P_{t2} = 224kW – heat output according to Chart no.13
k_{cw2}= 1 – according to Chart no. 5
$\mathbf{P_t = P_{t2} \times k_{cw2}}$ = 224 x 1 = 224kW – maximum power that can be transmitted via gearbox at fan cooling.
$P_t > P_V$ (224 > 180) kW – This data indicates that fan cooling is sufficient.

7.5.4 Inspection of locked-rotor torque.

Maximum locked-rotor torque of motor may not exceed rated torque of gearbox on input shaft of gearbox multiplied by 1,8.
M_{max}= 1,8 x 9550 x P_1 / n_1 =1,8 x 9550 x 373 / 1500 = 4274,58Nm

Locked-rotor torque of electromotor from catalogue of electromotors:
M_z = 2,2 x M_n = 2,2 x 9550 x P_e / n_1 = 2,2 x 9550 x 200 / 1500 = 2801,3Nm

$M_z < M_{max}$ - this data indicates that permissible locked-rotor torque will not be exceeded.

If power drive does not meet this condition, it may be achieved in operation e.g. by controlled start of powertrain (double reduction motors, frequency converter etc.), using a clutch with soft characteristics.

8. POWER CHARTS

8.1 Double reduction spur gearboxes TSP2

8.1.1 Nominal gears, revolutions, power

Chart no. 7

Nominal gear i_n (real gear in brackets)	Revolutions (only for reference – real revs depend on type of power drive used)		Gearbox power P_1 in kW
	Input n_1 [rpm]	Output (calculated from n_1=1450, 950 a 700 rpm n_2 [rpm]	
5 (5,022)	*1500**	*288,7**	*1039**
	1000	*189,2*	*773*
	750	*139,4*	*587*
6,3 (6,391)	*1500**	*226,9**	*1039**
	1000	148,6	773
	750	109,5	587
8 (7,862)	*1500*	*184,4*	*897*
	1000	120,8	667
	750	89	538
10 (9,923)	1500	146,1	796
	1000	95,7	592
	750	70,5	465
12,5 (12,526)	1500	115,7	681
	1000	75,8	501
	750	55,9	366
16 (15,906)	1500	91,2	549
	1000	59,7	392
	750	44	287
20 (19,894)	1500	72,9	466
	1000	47,7	305
	750	35,2	222
25 (24,737)	1500	58,6	374
	1000	38,4	244
	750	28,3	178
31,5 (31,053)	1500	46,7	216
	1000	30,6	140
	750	22,5	102

* Gears 5 and 6,3 may operate only at input revolutions 1500 rpm only with special closed circuit lubrication, that is not a part of default equipment.

8.1.2 Heat output

Chart no. 8

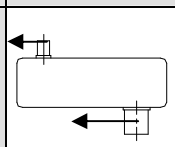
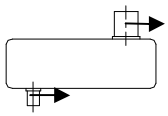
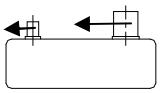
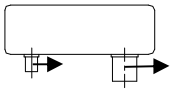
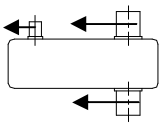
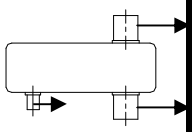
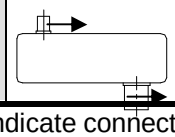
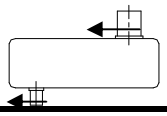
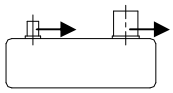
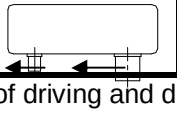
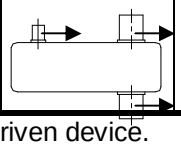
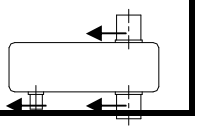
Cooling method		Gearbox heat output P_t in kW
Without cooling	P_{t1}	206
With fan cooling	P_{t2}	255
With embedded cooling circuit	P_{t3}	297

The TSP2-355 gearboxes are designed for transmission of catalogue load in the direction of input shaft rotation according to Charts no. 9 and 10. Marking 1 to 6 is applied to direction of clockwise input shaft rotation and values 1R to 6R to direction of anti-clockwise input shaft rotation. If it is necessary to use gearbox for both directions of input shaft rotation, size of power transmitted must be consulted with gearbox manufacturer, since power transmitted is lower at reverse.

♦ TSP2 – 355 - J

Foot version with solid output shaft

Chart no. 9

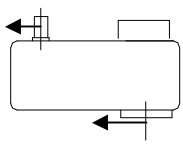
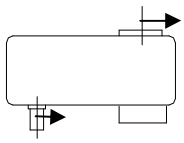
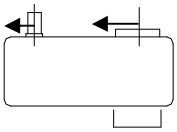
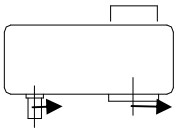
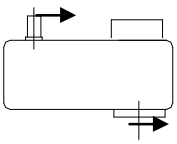
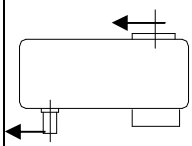
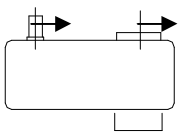
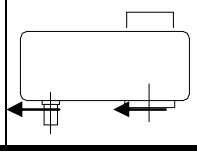
Supplementary no.	1	2	3	4	5	6
Arrangement of ends and shaft running direction						
Supplementary no.	1R	2R	3R	4R	5R	6R
Arrangement of ends and shaft running direction						

Arrows indicate connection point and running direction of driving and driven device.

♦ TSP2 – 355 - DS

Foot version with hollow output shaft and cone shaft clamping element

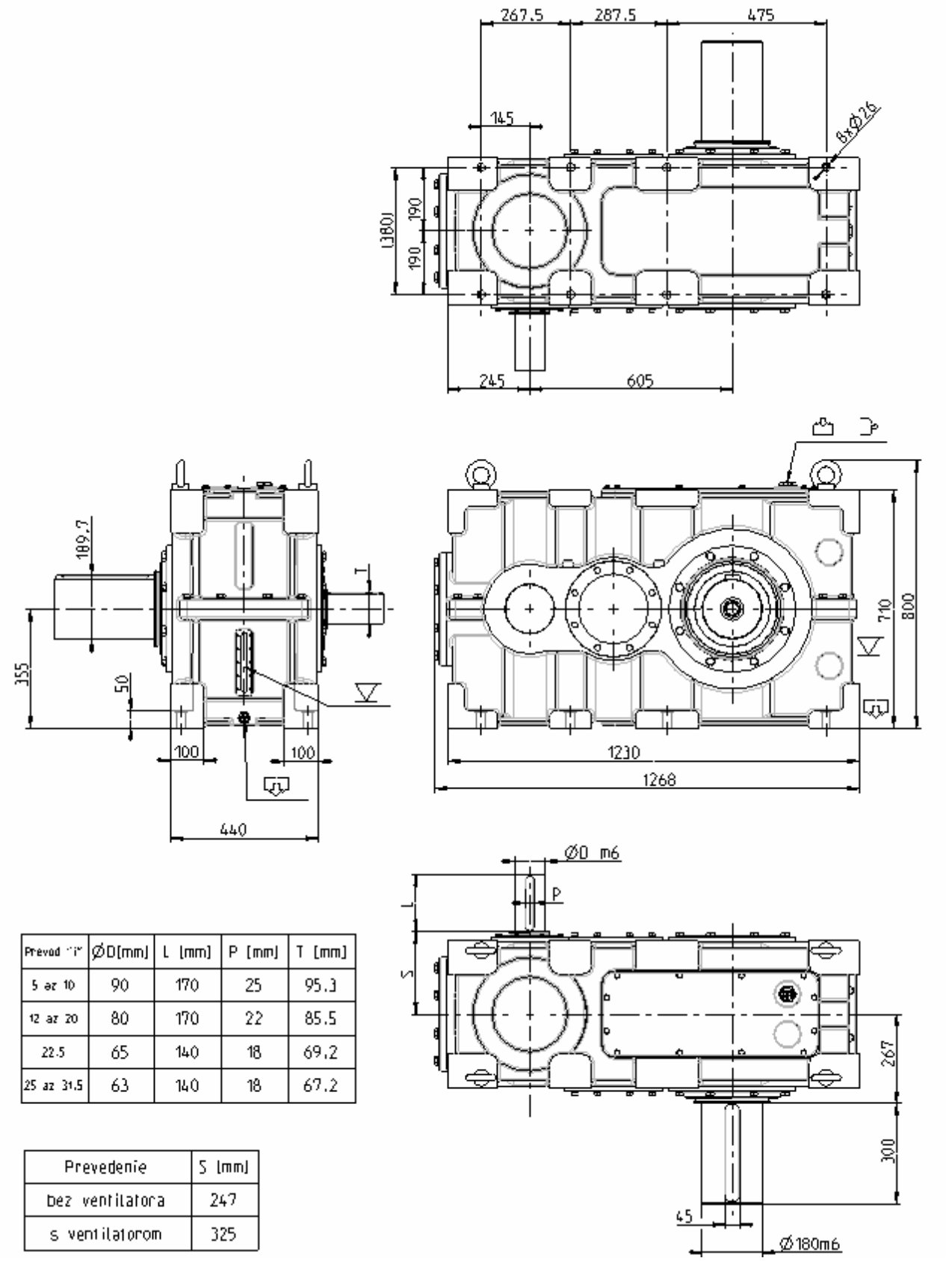
Chart no. 10

Supplementary no.	1	2	3	4
Arrangement of ends and shaft running direction				
Supplementary no.	1R	2R	3R	4R
Arrangement of ends and shaft running direction				

Arrows indicate connection point and running direction of driving and driven device.

8.1.3 Connecting dimension of TSP2-355-J type gearbox

Scheme no.2



Prevod "i"	ØD[mm]	L [mm]	P [mm]	T [mm]
5 až 10	90	170	25	95.3
12 až 20	80	170	22	85.5
22.5	65	140	18	69.2
25 až 31.5	63	140	18	67.2

Prevedenie	S [mm]
bez ventilátora	247
s ventilátorom	325

Approximate weight of TSP2-355 gearboxes is 1355kg.

8.2 Triple reduction spur gearboxes TSP3

8.2.1 Nominal gears, revolutions, power

Chart no.12

Nominal gear i_n (real gear in brackets)	Revolutions (only for reference – real revs depend on type of power drive used)		Gearbox power P_1 in kW
	Input n_1 [rpm]	Output (calculated from n_1=1450, 950 a 700 rpm n_2 [rpm]	
20 (20,101)	1500	72,1	464
	1000	47,3	315
	750	34,8	230
25 (25,287)	1500	57,3	360
	1000	37,6	254
	750	27,7	186
31,5 (31,393)	1500	46,2	309
	1000	30,3	205
	750	22,3	150
40 (39,627)	1500	36,6	252
	1000	24,0	165
	750	17,7	122
50 (50,926)	1500	28,5	195
	1000	18,7	127
	750	13,7	93
63 (63,239)	1500	22,9	158
	1000	15,0	103
	750	11,1	75
80 (80,356)	1500	18,0	117
	1000	11,8	76
	750	8,7	56
100 (100,218)	1500	14,5	93
	1000	9,5	60
	750	7,0	44
125 (124,756)	1500	11,6	64
	1000	7,6	44
	750	5,6	34

8.2.2 Heat output

Chart no.13

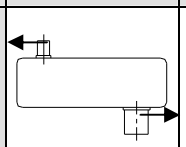
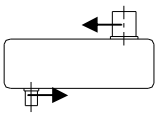
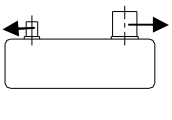
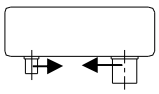
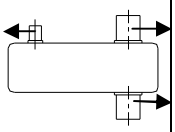
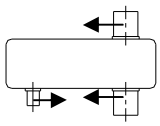
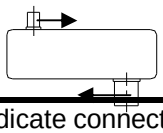
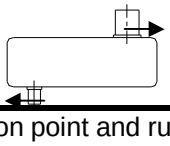
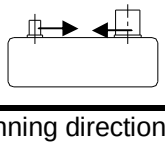
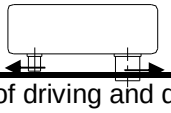
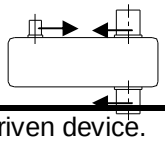
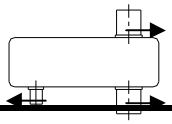
Cooling method		Gearbox heat output P_t in kW
Without cooling	P_{t1}	147
With fan cooling	P_{t2}	182
With embedded cooling circuit	P_{t3}	212

The TSP3-355 gearboxes are designed for transmission of catalogue load in the direction of input shaft rotation according to Charts no. 9 and 10. Marking 1 to 6 is applied to direction of clockwise input shaft rotation and values 1R to 6R to direction of anti-clockwise input shaft rotation. If it is necessary to use gearbox for both directions of input shaft rotation, size of power transmitted must be consulted with gearbox manufacturer, since power transmitted is lower at reverse.

♦ TSP3 – 355 - J

Foot version with solid output shaft

Chart no.14

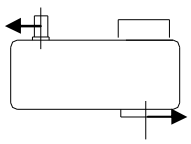
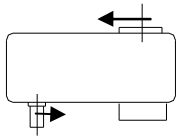
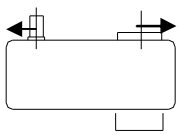
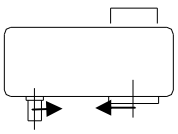
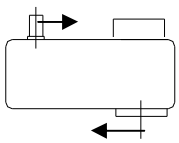
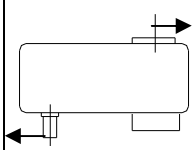
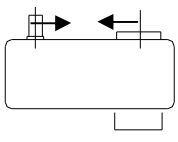
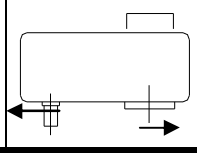
Supplementary no.	1	2	3	4	5	6
Arrangement of ends and shaft running direction						
Supplementary no.	1R	2R	3R	4R	5R	6R
Arrangement of ends and shaft running direction						

Arrows indicate connection point and running direction of driving and driven device.

♦ TSP3– 355 - DS

Foot version with hollow output shaft and cone shaft clamping element

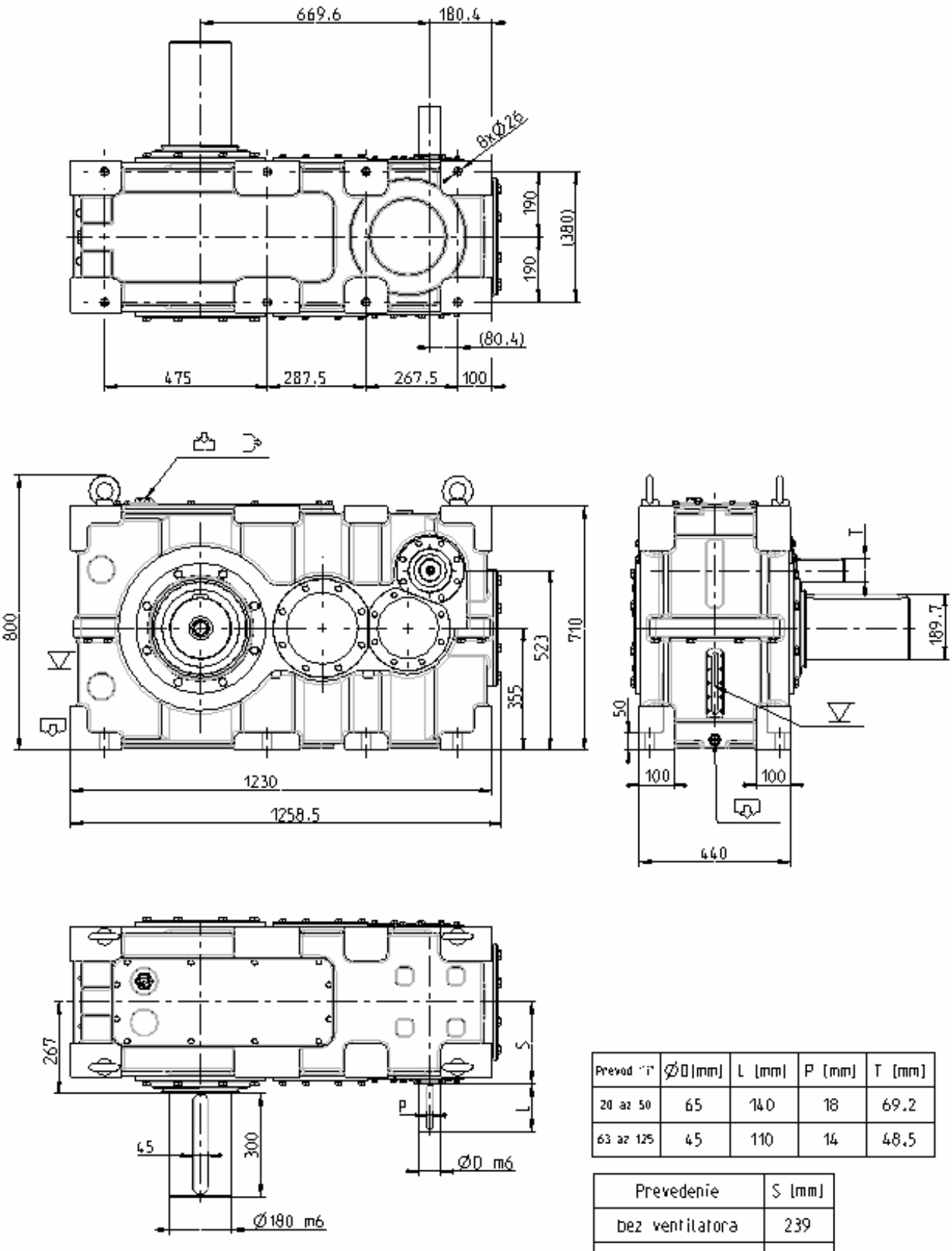
Chart no. 15

Supplementary no.	1	2	3	4
Arrangement of ends and shaft running direction				
Supplementary no.	1R	2R	3R	4R
Arrangement of ends and shaft running direction				

Arrows indicate connection point and running direction of driving and driven device.

8.2.3 Connecting dimension of TSP3-355-J type gearbox

Scheme no. 3



Prevod "i"	ØD [mm]	L [mm]	P [mm]	T [mm]
20 až 50	65	140	18	69.2
63 až 125	45	110	14	48.5

Prevedenie	S [mm]
bez ventilatora	239
s ventilatorom	325

Approximate weight of TSP3-355 gearboxes is 1370kg.

8.3 Triple reduction bevel and spur gearboxes TSR3

TSR3-355

8.3.1 Nominal gears, revolutions, power

Chart no. 17

Nominal gear i_n (real gear in brackets)	**Revolutions** (only for reference – real revs depend on type of power drive used)		**Gearbox power** P_1 **in kW**
	Input n_1 **[rpm]**	**Output** (calculated from n_1=1450, 950 a 700 rpm n_2 **[rpm]**	
20 (19,329)	1500	75,0	470
	1000	49,1	313
	750	36,2	230
25 (25,165)	1500	57,6	356
	1000	37,8	260
	750	27,8	192
31,5 (32,2)	1500	45,0	300
	1000	29,5	203
	750	21,7	150
40 (39,573)	1500	36,6	252
	1000	24,0	165
	750	17,7	122
50 (51,012)	1500	28,4	195
	1000	18,6	128
	750	13,7	93
63 (63,137)	1500	23,0	132
	1000	15,0	86
	750	11,1	63
80 (79,577)	1500	18,2	114
	1000	11,9	74
	750	8,8	54
100 (99,471)	1500	14,6	95
	1000	9,6	62
	750	7,0	45
125 (126,316)	1500	11,5	64
	1000	7,5	45
	750	5,5	34

8.3.2 Heat output

Chart no. 18

Cooling method		Gearbox heat output P_t in kW
Without cooling	P_{t1}	154
With fan cooling	P_{t2}	235
With fan and embedded cooling circuit	P_{t3}	299

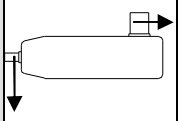
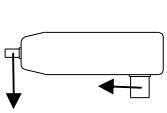
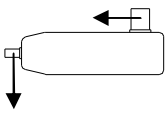
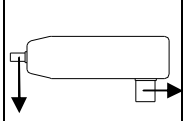
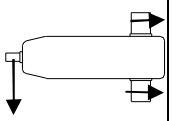
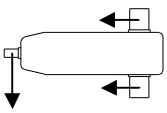
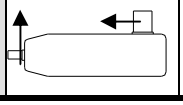
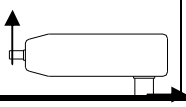
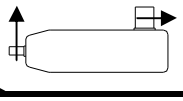
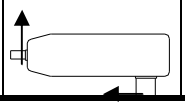
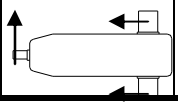
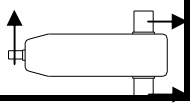
TSR3-355

The TSR3-355 gearboxes are designed for transmission of catalogue load in the direction of input shaft rotation according to Charts no. 9 and 10. Marking 1 to 6 is applied to direction of clockwise input shaft rotation and it is necessary to use them in preference. ***The 1R to 6R values for direction of anti-clockwise input shaft rotation may be selected only exceptionally, if is is impossible to provide for clockwise input shaft rotation.*** If it is necessary to use gearbox for both directions of input shaft rotation, size of power transmitted must be consulted with gearbox manufacturer, since power transmitted is lower at reverse.

♦ TSR3 - 355 - J

Foot version with solid output shaft

Chart no. 19

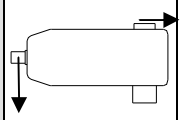
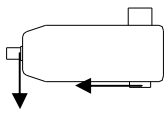
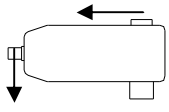
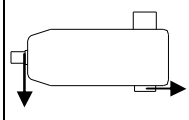
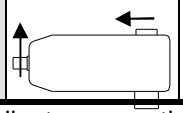
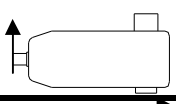
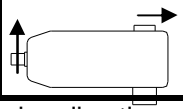
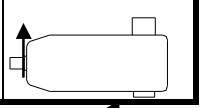
Supplementary no.	**1**	**2**	**3**	**4**	**5**	**6**
Arrangement of ends and shaft running direction						
Supplementary no.	1R	2R	3R	4R	5R	6R
Arrangement of ends and shaft running direction						

Arrows indicate connection point and running direction of driving and driven device.

♦ TSR3 - 355 - DS

Foot version with hollow output shaft and cone shaft clamping element

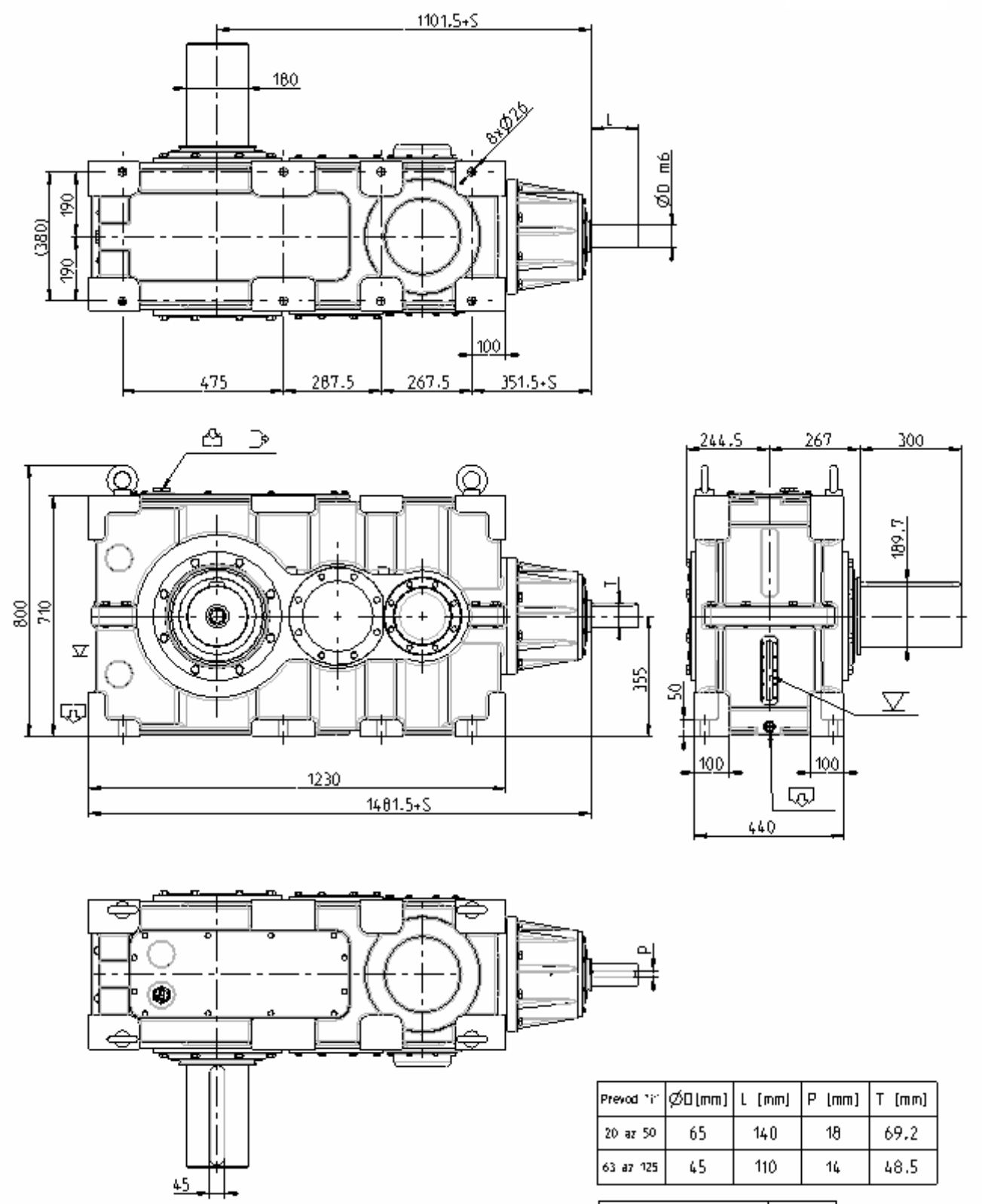
Chart no. 20

Supplementary no.	**1**	**2**	**3**	**4**
Arrangement of ends and shaft running direction				
Supplementary no.	1R	2R	3R	4R
Arrangement of ends and shaft running direction				

Arrows indicate connection point and running direction of driving and driven device.

8.3.3 Connecting dimension of TSR3-355-J type gearbox

Scheme no. 4



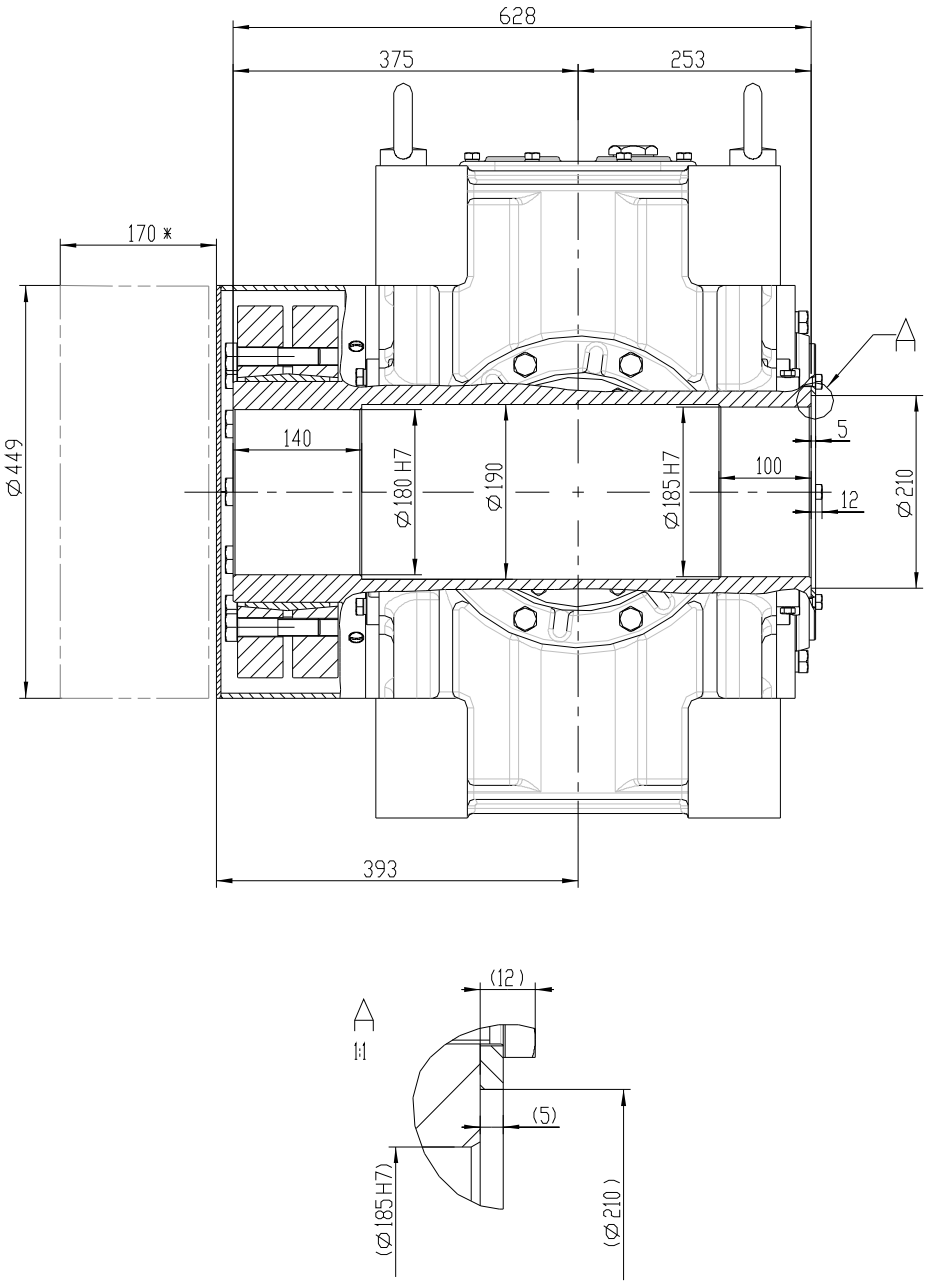
Prevod "i"	ØD [mm]	L [mm]	P [mm]	T [mm]
20 az 50	65	140	18	69.2
63 az 125	45	110	14	48.5

Prevedenie	S [mm]
bez ventilatora	0
s ventilatorom	78

Approximate weight of TSR3-355 gearboxes is 1410kg.

8.4 Connecting dimension of hollow output shaft

Scheme no. 5



170* - minimum space for assembly and disassembly of clutch housing

Technical form for gearbox design.

Customer (company name):..... Enquiry no.:.....
Processed by (name, title):.....
Phone.:..... Fax:..... e-mail: .....
Project / country of destination .....
Gearbox type and version (check box next to required parameters):

TS | P / R | 2 / 3 | - 355 - | J / DS / * | - | 1R / 2R / 3R / 4R / 5R / 6R / * | - [ ] - [ ] rpm

Required gear ratio

Revolutions on input shaft of gearbox

* other version – please describe:
.....
.....
.....

POWER DRIVE

Electromotor ☐ Combustion 4+ cylinder engine ☐ Combustion 1 to 3 cylinder engine ☐
Turbine ☐ Hydraulic motor ☐ ** ☐

** other power drive – please describe:
.....
.....

Rated gearbox power: ..... kW Revolutions on input shaft of gearbox: ..... rpm
Locked-rotor torque is ..... -multiple of rated torque of power drive (according to data of power drive manufacturer).

DRIVEN MACHINE
Type of driven machine (please indicate, what kind of machine is in question):
.....
.....

Work nature: light [I] medium [II] heavy [III]
Examples for determination of work nature are referred to in Chart no. 7.

Real power demand ..... kW Net operation time per day..... hrs.
Net operation time per hour ..... % Startup count per hour .....

ENVIRONMENT

Prevailing ambient temperature .....°C
Ambient temperature variation throughout the year: maximum value .....°C
minimum value .....°C
Description of environment (humidity, dust nuisance, chemical contamination etc.)
.....
.....
.....
.....

REQUIREMENTS ON SPECIAL ACCESSORIES

Gearbox cooling: Fan ☐ Water cooling ☐ Outer circuit with cooler ☐

Oil preheating ☐ Device guarding against reverse of gearbox after power drive shutoff ☐

Gearbox monitoring: Vibrations ☐ Oil flow ☐ Housing temperature ☐ Oil temperature ☐

Other special requirements:

.....

.....

.....

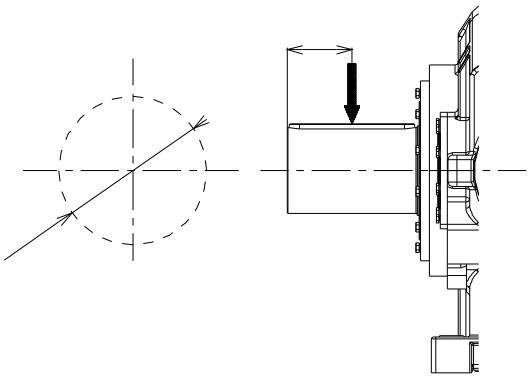
.....

Language to be used in accompanying documentation:

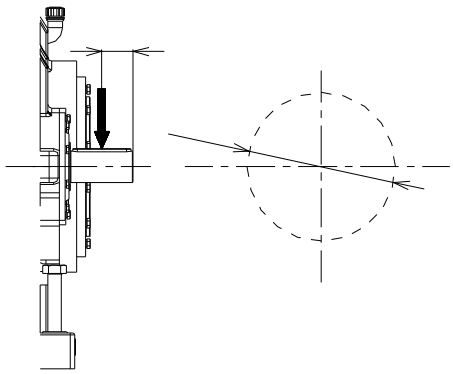
Slovak ☐ English ☐ German ☐ Polish ☐

LOCATION AND DIRECTION OF APPLICATION OF AUXILIARY FORCES

Location and direction of auxiliary force application for output shaft



Location and direction of auxiliary force application for input shaft



It is necessary to draw direction and location of auxiliary forces to the scheme according to instructions in Chapter 4. It is necessary to draw auxiliary force direction in side projection as in view on the front of shaft end (applicable for all versions).