Selector sleeves for gearboxes in mobile machinery

Features

Selector sleeves are used in gearboxes with single cone and multiple cone synchronisers. They facilitate gearshift in manual gearboxes and transmit the torque from the gearbox shaft via the selector hub and gear cone body to the gear.

Design of the selector sleeve

The design of the selector sleeve is characterised by numerous design details, *Figure 1*.

Roof and lead angle

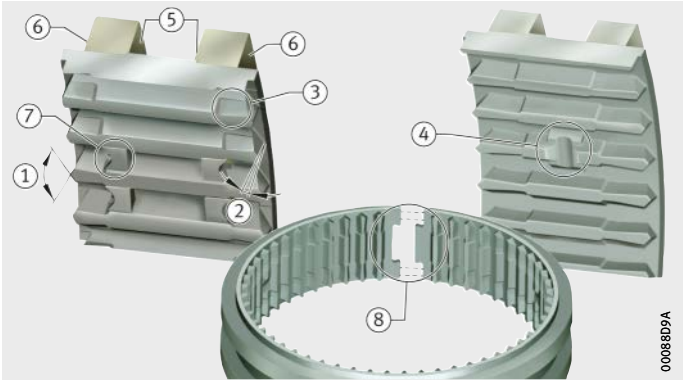
The roof angle is matched to the teeth of the synchro outer ring. The lead angle describes the inclination of the roof apex, ensures easier meshing of the clutching teeth and thus assists in achieving gearshift comfort.

Recess

The recess prevents, for example, the clutching teeth on the selector sleeve separating from the gear cone body in the engaged condition.

Presynchronisation slot

The struts engage in the presynchronisation slot or securing ramp of the selector sleeve. The ramp profiles on both sides ensure that, when the selector sleeve is displaced, the struts are moved, pressed axially against the synchro outer ring and thus activate presynchronisation. The profile of the presynchronisation slot also influences gearshift comfort.



① Roof angle
② Lead angle
③ Recess
④ Presynchronisation slot
⑤ Gearshift fork slot
⑥ Thrust washers
⑦ End stop
⑧ Clinch

Figure 1
Design of the selector sleeve

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Gearshift fork slot and thrust washers

The gearshift fork locates in the gearshift fork slot. It presses against the thrust washers and displaces the selector sleeve in an axial direction during gearshift.

End stop

The end stop restricts the axial displacement distance of the selector sleeve, since the clutch teeth of the gear cone body is precisely defined in position.

Clinch/butt joint

The clinch or butt joint is a special feature of selector sleeves from Schaeffler and can be attributed to the manufacturing process. The resulting gap in the teeth can be used as an aid for mounting the selector sleeve in the correct position.

Manufacturing process

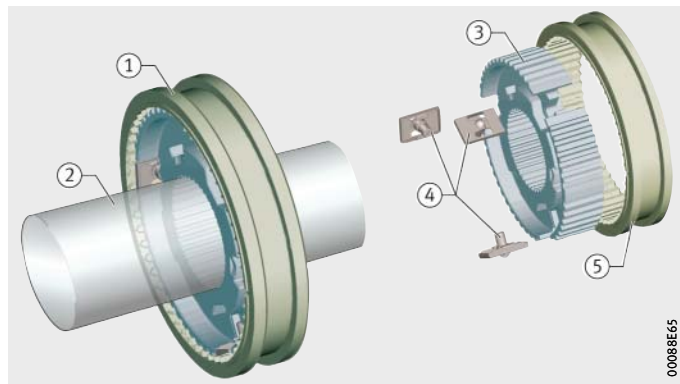
A special feature of selector sleeves from Schaeffler is manufacture by forming technology, without the generation of swarf.

The advantages of selector sleeve manufacture at Schaeffler include:

- 100% inspection of functionally relevant features
- wide range of designs and variants
- efficient material utilisation
- small dimensional fluctuations
- high surface quality
- high reproducibility in the case of off-tool dimensions
- optimised manufacturing costs
- technological concept for high volumes
- continuous grain orientation in areas subjected to stresses.

Selector sleeve unit

In addition to the supply of individual components, Schaeffler also offers complete selector sleeve units. A unit of this type comprises the selector hub, the struts for the presynchroniser and the selector sleeve, *Figure 2*.



① Selector sleeve unit
② Gearbox shaft

Components:
③ Selector hub
④ Struts
⑤ Selector sleeve

Figure 2
Selector sleeve unit

The advantages of the selector sleeve unit compared to the supply of individual components include:

- simplified mounting on the gearbox shaft
- reduced number of individual parts, giving simpler handling in the manufacturing process
- favourable tolerance chain due to the supply of all components from the same manufacturer
- functionally verified, independent unit.

Application in mobile machinery

As a development partner and supplier for gearbox components over many years in the automotive industry, Schaeffler has built up extensive know-how. In the light of continuously increasing demands on gearboxes, this can now also be used to considerable benefit for applications in mobile machinery.

Contemporary developments in the mobile machinery sector include the transition from non-synchronised to synchronised gearboxes, principally in Asia, or the introduction of automated gearshift processes due to the new concept of dual clutch gearboxes. Both these developments require a synchronisation function and thus the use of selector sleeves.

Advantages

Selector sleeves from Schaeffler offer numerous advantages in the mobile machinery sector:

- The supply of complete selector sleeve units gives simpler mounting and handling
- Joint development projects can be carried out on various issues:
  - design of selector sleeves and other components for synchonisation by means of the calculation program BEARINX®
- The solution is optimised for cost due to the use of forming technology for manufacture and components from existing volume production can be matched to the design envelope in mobile machinery
- High component quality is achieved by the use of forming technology for manufacture
- Gearshift comfort is improved through the production of functional surfaces free from burrs.

Available designs

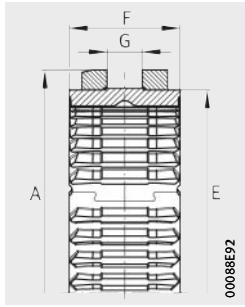
The following dimension table gives an overview of existing designs of selector sleeves, which can be used to cover a wide range of applications.

Further information

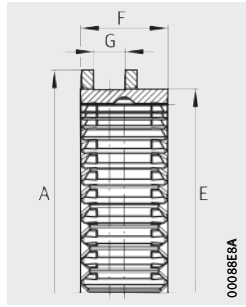
- TPI 125, INA Selector Hub Assembly.

Selector sleeves

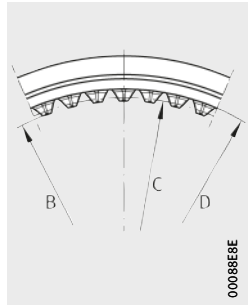
Available designs for mobile machinery



Symmetrical



Asymmetrical



Tooth set

Dimension table · Dimensions in mm

Designation	Maximum torque Nm	Dimensions A	E	F	G	Roof angle[1] °		Tooth set B	C	D	Modulus	Position of gear-shift fork relative to base body
S1	**1 000**	**102**	**91,5**	19,47	9,85	114	–	84,05	85,32	88,6	**1,58**	Symmetrical
S2	**1 400**	**105,6**	**97**	23,13	9,15	85	80	88,15	90	91,8	**1,5**	Asymmetrical
S3	**1 400**	**91,3**	**86,1**	19,77	10,35	90	120	79,05	81	82,36	**1,5**	Symmetrical
S4	**1 200**	**101**	**92,1**	19,77	7,1	84	–	84,05	85,32	88,6	**1,58**	Asymmetrical
S5	**1 000**	**96,1**	**86,1**	19,77	9	90	120	79,05	81	82,36	**1,5**	Symmetrical
S6	**1 400**	**105,6**	**97**	23,13	9,15	85	80	88,15	90	91,8	**1,5**	Asymmetrical
S7	**1 600**	**104,1**	**95,55**	25,8	8,1	85	92	87,3	86,4	91,65	**1,6**	Symmetrical
S8	**1 600**	**104,1**	**95,55**	25,8	8,1	85	117	87,3	86,4	91,65	**1,6**	Symmetrical
S9	**1 000**	**114,9**	**106,9**	21,3	10,1	115	–	97,5	96	102,3	**2**	Symmetrical
S10	**2 000**	**116,5**	**107,6**	23,8	12,05	115	90	99,4	102	102,95	**1,7**	Symmetrical
S11	**1 200**	**104,9**	**96,9**	21,5	10,05	115	–	87,6	90	92,4	**2**	Symmetrical
S12	**1 200**	**96,5**	**88,4**	19,36	8,75	117	–	80,2	81,6	84,6	**1,7**	Symmetrical
S13	**1 800**	**127**	**114**	23,2	8,28	110	–	104,6	108,3	109,2	**1,9**	Symmetrical
S14	**1 200**	**104**	**91**	21,4	8,28	110	–	81,8	85,5	86,4	**1,9**	Symmetrical
S15	**1 800**	**123**	**114**	22,8	8,28	110	–	104,6	108,3	109,2	**1,9**	Symmetrical
S16	**1 000**	**89,3**	**80,25**	20,65	7,15	90	116	71,75	73,5	76,1	**1,75**	Asymmetrical
S17	**1 000**	**89,3**	**80,25**	20,65	8,05	90	116	71,75	73,5	76,1	**1,75**	Asymmetrical
S18	**1 000**	**89,3**	**80,25**	22,5	8,05	90	116	71,75	73,5	76,1	**1,75**	Asymmetrical
S19	**1 000**	**92,3**	**80,25**	20,2	8,05	116	–	71,75	73,5	76,1	**1,75**	Asymmetrical

[1] If two values are given for the roof angle: alternative designs are available.

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