Synchro intermediate rings for gearboxes in mobile machinery

Features

In manual gearboxes, synchronisation systems match the different speeds of the gear to be engaged and the gearshift element located non-rotatably on the shaft to each other.

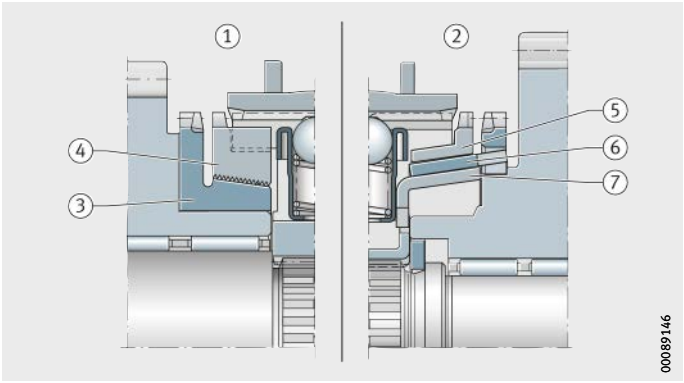
Single cone and multiple cone synchronisation

The cone friction clutch corresponds to the state of the art in synchronisation systems for mechanical manual gearboxes in vehicles. It is designed in the form of a locking synchroniser, either as a single cone or multiple cone synchroniser. In applications in mobile machinery, the multiple cone synchronisation system normally used is the double cone synchroniser, *Figure 1*.

The essential difference between a single cone and multiple cone synchroniser is the number of friction surfaces.

An increase in the size of the friction surface of the single cone synchroniser reduces the wear during clutch operation. The frictional force and frictional torque remain unchanged.

In multiple cone synchronisation systems, the friction surface is expanded by means of intermediate rings. Due to the arrangement of the friction surfaces, the gearshift force acts on several surfaces. As a result, a higher frictional torque can be achieved.



① Single cone synchroniser
② Double cone synchroniser

③ Gear cone body
④ Conventional synchro ring
⑤ Synchro ring, outer
⑥ Synchro intermediate ring
⑦ Synchro ring, inner

Figure 1
Synchronisation systems

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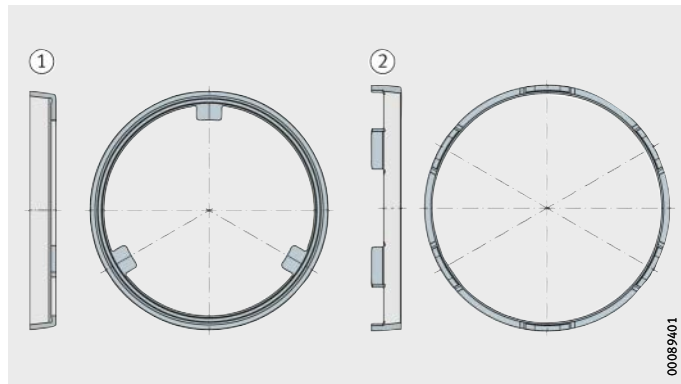
Designs

The shape of a synchro intermediate ring is dependent on the adjacent construction. The drive lugs acting as an anti-rotation lock can be arranged on the inside or the outside, *Figure 2*. Various designs are available, *Figure 3*.

Circumferential ribs allow thin but geometrically stable ring cross-sections. Thin-walled intermediate rings with a uniform wall thickness give better contact with the cone surfaces of the adjacent components.



① Anti-rotation lock on inside
② Anti-rotation lock on outside

Figure 2
Anti-rotation lock

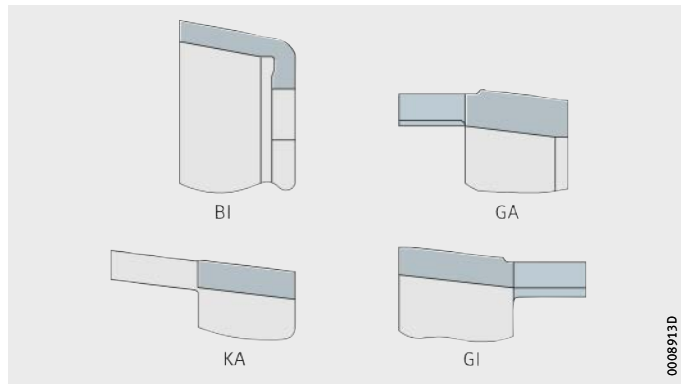


Figure 3
Designs

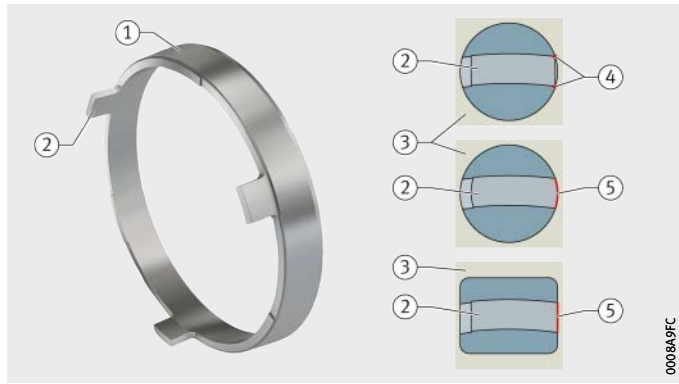
Production

Synchro intermediate rings from Schaeffler are manufactured from thin-walled, through hardenable steel strip. After hardening, the inner and outer cone are precision ground. The cone friction surfaces are then honed.

Contact surfaces of the drive lugs

In the contact area between the drive lug and the adjacent component, line contact leads to increased contact pressure. This increases the risk of fracture as well as wear. A flat contact area between the drive lug and the adjacent component is therefore desirable, *Figure 4*, page 3.

Since non-cutting production is used, the profile required on the drive lugs can be produced without increased costs.



① Synchro intermediate ring
② Drive lug
③ Adjacent component
④ Line contact (critical)
⑤ Surface contact

Figure 4
Contact area between drive lug and adjacent component

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, in the case of a multiple cone synchroniser, the use of synchro intermediate rings.

Advantages

Synchro intermediate rings from Schaeffler offer numerous advantages in the mobile machinery sector:

- Joint development projects can be carried out on various issues:
  - design of synchro intermediate rings and other components for synchonisation by means of the calculation program BEARINX®
- The friction cones have high dimensional accuracy due to the use of grinding and honing
- The design is both robust and optimised for cost due to the use of forming technology
- Existing designs can easily be matched to a specific design envelope
- Due to the versatile design possibilities of the drive lugs, the existing adjacent construction in the gearbox can be retained.

Available designs

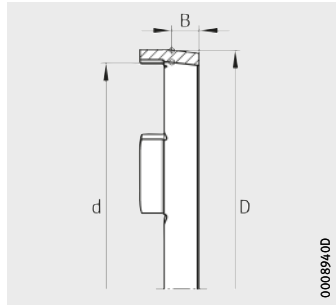
The following dimension table gives an overview of existing designs of synchro intermediate rings, which can be used to cover a wide range of applications.

Further information

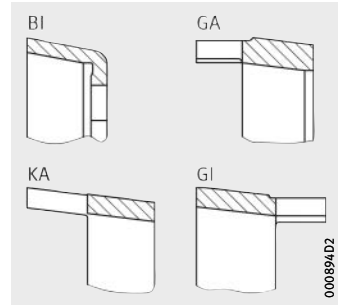
- API 06, Intermediate Rings for Multi-Cone Synchronizer Systems
- Further information on the subject of synchronisation:
  TPI 125, INA Selector Hub Assembly.

Synchro intermediate rings

Available designs
for mobile machinery



Synchro intermediate ring
Design GA



Designs

Dimension table · Dimensions in mm

Designation	Dimensions			Design
	d	D	B	
SYRI	**49,5**	54	13,6	GA
SYRZ	**50,5**	55,5	12,4	KA
SYRZ	**52**	55,5	8,65	BI
SYRZ	**52,05**	55,75	13,25	GA
SYRZ	**54**	58	11,6	GA
SYRZ	**54,5**	58	9,4	BI
SYRZ	**54,5**	58	12	KA
SYRZ	**55,663**	61,663	12,8	GA
SYRZ	**55,975**	61,975	14,3	GA
SYRZ	**56,24**	61,233	10,9	GA
SYRZ	**58**	62	12,2	GA
SYRZ	**58,975**	63,975	14,3	GA
SYRZ	**59**	62,5	8,35	BI
SYRZ	**60,25**	64,25	11,5	GA
SYRZ	**61,508**	64,939	14,26	KA
SYRZ	**62**	66	11,3	GA
SYRI	**63,6**	68	15,2	GI
SYRZ	**64,241**	69,274	11	GA

Dimension table (continued) · Dimensions in mm

Designation	Dimensions			Design
	d	D	B	
SYRZ	**65**	70	11,4	GA
SYRZ	**66,66**	71,66	11	KA
SYRZ	**66,9**	70,9	11,5	GI
SYRZ	**67**	71	11,4	GI
SYRZ	**67,559**	73,056	11	GA
SYRZ	**68,929**	73,826	11	GA
SYRZ	**69,7**	73,7	11	GA
SYRZ	**71**	77	11,95	GA
SYRZ	**73,2**	79,2	11,3	GA
SYRI	**73,5**	78,5	10,15	BI
SYRZ	**80,7**	86,7	11,65	GA
SYRZ	**84,136**	89,633	11	GA
SYRZ	**88**	93	17,2	GA
SYRZ	**89,237**	93,937	11,4	GI
SYRZ	**98**	102	9,9	BI
SYRZ	**102,658**	107,658	16,75	GA
SYRZ	**111**	115	9,9	BI
SYRI	**121,31**	127,876	19,2	GI

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