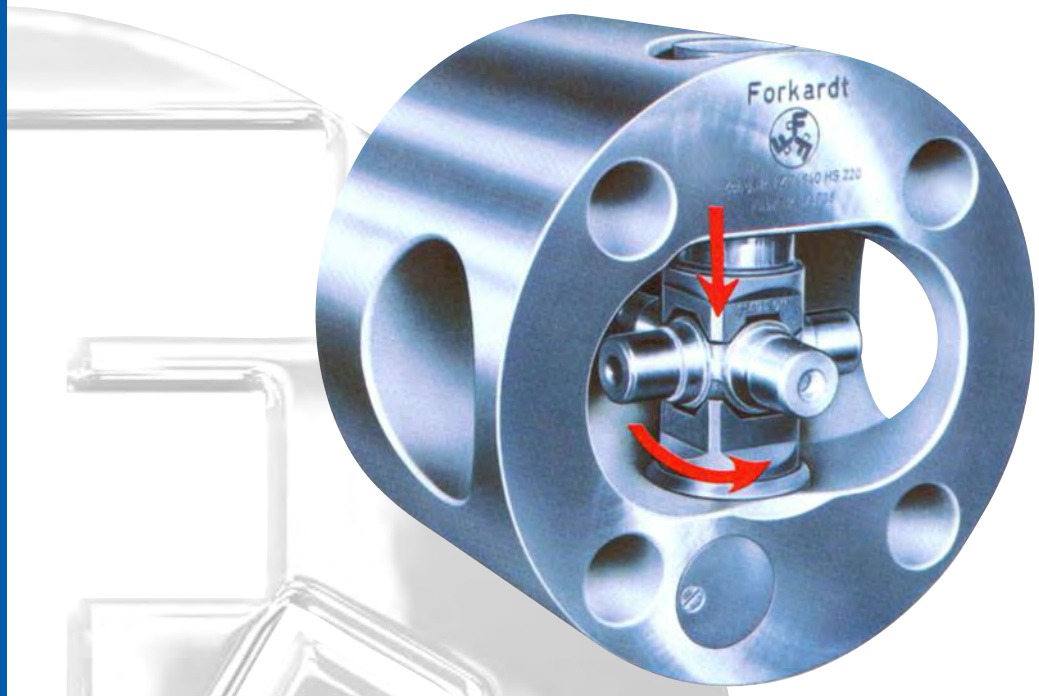
FORKARDT

HSR (T)

AUTOMATIC
INDEXING CHUCK



ENGLISH

OPERATING INSTRUCTIONS

FORKARDT GMBH

Lachenhauweg 12

72766 Reutlingen-Mittelstadt

GERMANY

dimo

General

The production and machining of components with intersecting axes has for a long time involved high processing expenditure.
These components were either processed on complicated special machines, on transfer lines or on conventional lathes in several chucking operations with accordingly high ancillary times.
It is, without doubt, the merit of FORKARDT to have initiated a new era. The development of the hydraulically operated indexing chuck was the prerequisite to become independent of the special machines and transfer lines used up to then for these processing methods.

Relatively uncomplicated turret lathes or, in the last time, numerically controlled lathes could now be used for the same machining operations due to the simple design, control and possibility of attachment of this indexing chuck.
The component could subsequently be machined in one chucking operation in fully automatic sequence of operations (with up to six indexing positions with running machine spindle). High rationalisation was the effect of this. In addition, one person could now - depending on the processing time of the component - operate several machines.

Hydraulically operated FORKARDT indexing chucks were initially used for producing cardan universal joints for the motor-car industry.
This was, however, not yet all. The range of components to be processed was considerably extended in the course of time. The development of the chuck programme was permanently continued according to the requirements.
Hydraulically operated Forkardt indexing chucks are at present not only used for machining components in large batches, but they offer high economical features even for small batches of components due to their short chucking and indexing times as well as their uncomplicated method of mounting.
The photographs below show an extract of the components, which can be machined in FORKARDT indexing chucks. The possibilities of application cover beer cocks as well as large gate valve bodies and drop forged high-pressure fittings for the reactor industry.

Important information for preparing a quotation and executing an order:

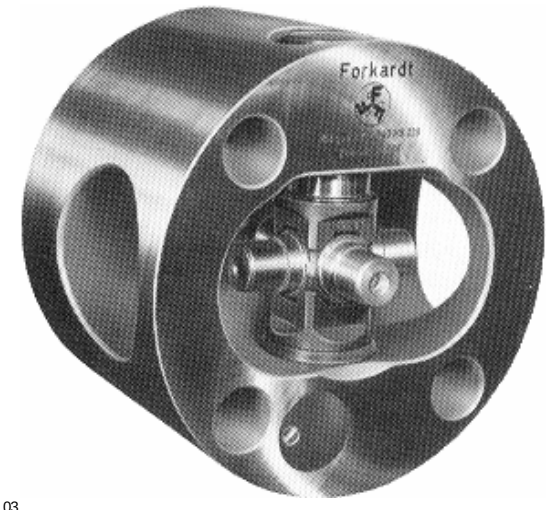
1. Component drawings with machining details.
2. Component samples (as they go into the indexing chuck)
3. Drawing of machine spindle
4. Largest possible chuck diameter
5. Information on voltage and frequency for power unit and solenoid valves

Assembly and Method of Operation of the Indexing Chuck, Type HSR (T):

Clamping, indexing, locking and unclamping of the jaws are performed by integral hydraulie cylinders. The oil is fed to the different cylinders via a multiple oil supply system mounted on the spindle end and a pipe bundle running through the spindle bore.

The chuck clamps unilaterally via the clamping piston of the lower jaw. Two hydraulically operated opposed flanges, working in sequence, index and lock the fulcrum pin.

The angular position of the jaws is matched to the number of component axes and maintained with a high degree of accuracy.



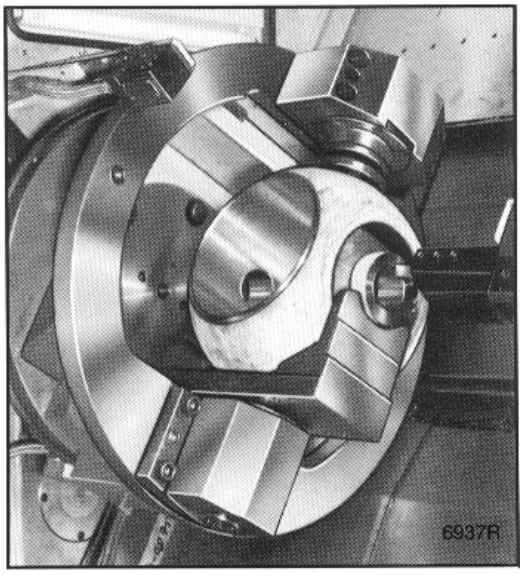
HSR 03

The rough component is automatically centered by the jaws, prisms and by the concentric clamping pressure. The successive machining cycle produces equal shapes (minimum out-of-balance) and dimensional accuracy.

The automatic indexing chuck is hydraulically controlled via two four-way solenoid valves.

In addition, the electrical circuit includes an adjustable time-lag relay to incorporate a short time-lag between the indexing and locking cycles.

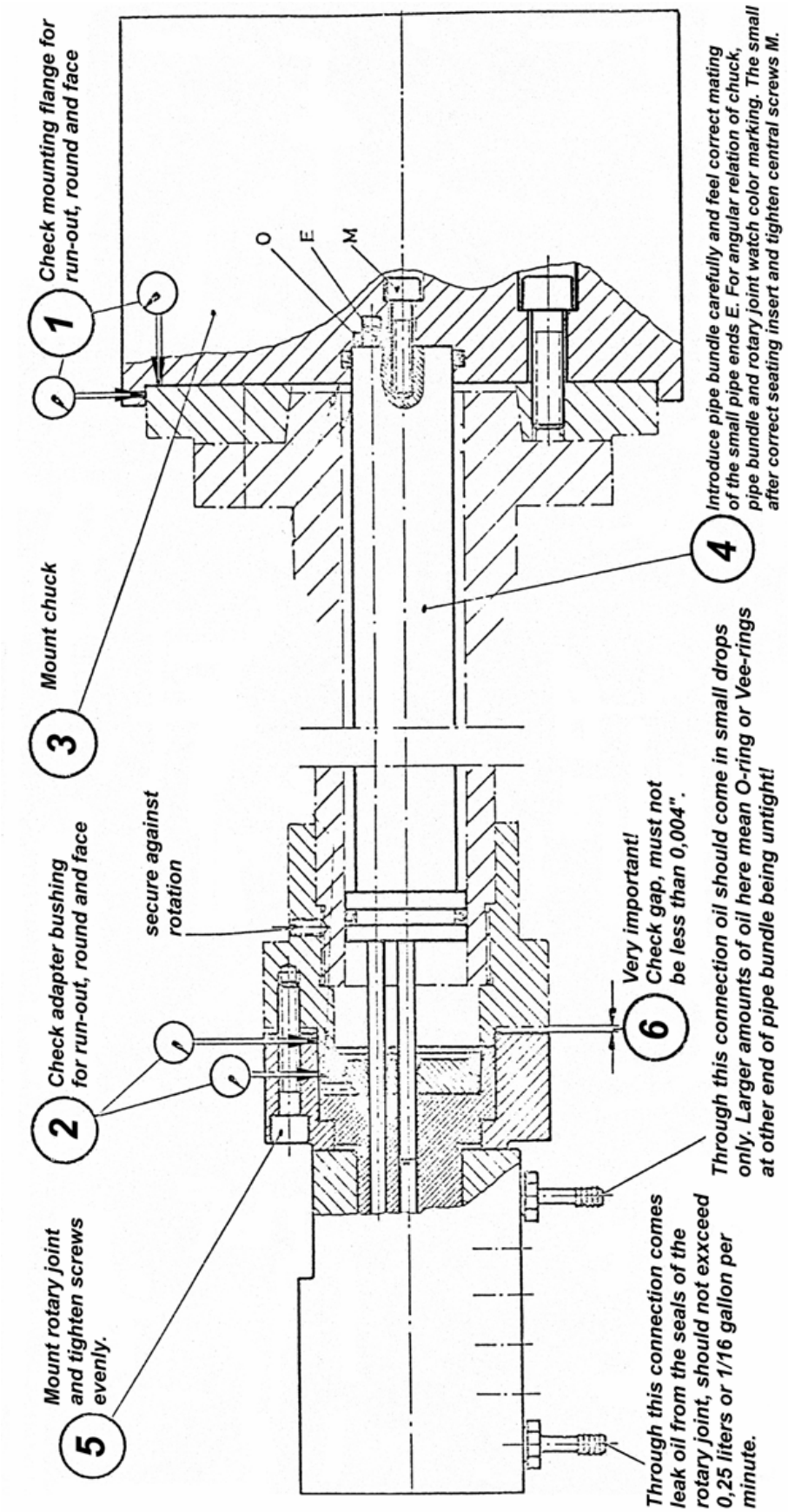
The completed indexing cycle is acknowledged via an additional oil channel, operating a control cylinder to actuate a limit switch or via proximity control scanning.



HSR 04

Control cylinder and limit switch are mounted on the hydraulic unit and on the solenoid control block. In case of proximity scanning the indexing mechanism cover will be designed according to the requirements of the customer.

In this way the appropriate programme sequence of the tools in relation to the workpiece position is warranted, so that a multiple machine assignment with sufficient safety and control can be performed at semiautomatic operating cycle.


1
Check mounting flange for run-out, round and face
O
E
M
3
Mount chuck
4
Introduce pipe bundle carefully and feel correct mating of the small pipe ends E. For angular relation of chuck, pipe bundle and rotary joint watch color marking. The small after correct seating insert and tighten central screws M.
2
Check adapter bushing for run-out, round and face
secure against rotation
6
Very important! Check gap, must not be less than 0,004".
Through this connection oil should come in small drops only. Larger amounts of oil here mean O-ring or Vee-rings at other end of pipe bundle being untight!
5
Mount rotary joint and tighten screws evenly.
Through this connection comes leak oil from the seals of the rotary joint, should not exxceed 0,25 liters or 1/16 gallon per minute.

HSR 05

Maintenance of the Chuck:

A.: The Indexing Mechanism

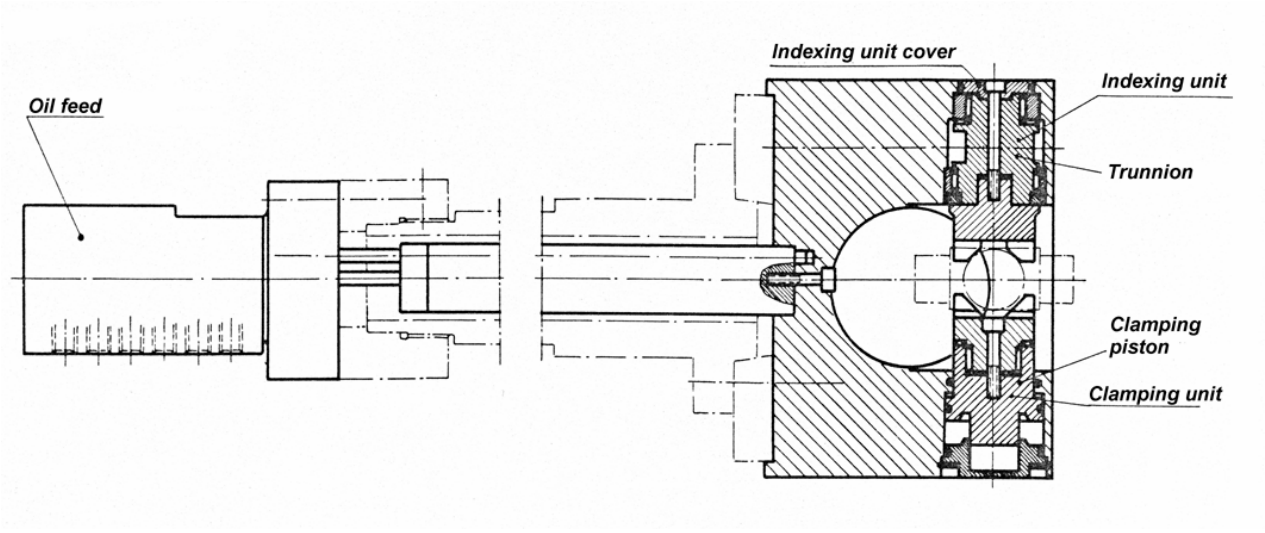
Once a week remove the cover on the face of the chuck and inspect the indexing trunnion for grease. Apply a good grade of bearing grease directly to the strunnion or through the fitting, whichever is convenient.
If the indexing mechanism is dirty, dismantle the indexing mechanism. Clean and treat the trunnion and indexing plungers with Molykote Paste G*, rubbing the lubricant in well with a stiff brush. Inspect the needle bearings for wear. Reassemble and apply bearing grease as above.

B.: The Chucking Mechanism

Remove the clamping insert and needle bearing. Inspect the bearing for wear and, if damaged, re-install with a fresh application **of** grease.
The bearing must be replaced occasionally. The frequency of replacement is a function of the type of material being machined, depth of cut und duty-cycle. After the chuck has been in operation for a time in mass production applications, and approximate bearing **life** expectancy has been established, it is possible to institute a periodic bearing replacement program. The bearings are inexpensive and are readily available from Fafnir INA Corporation of New Britain, Connecticut. See the replacement parts drawing on the next page of this manual.

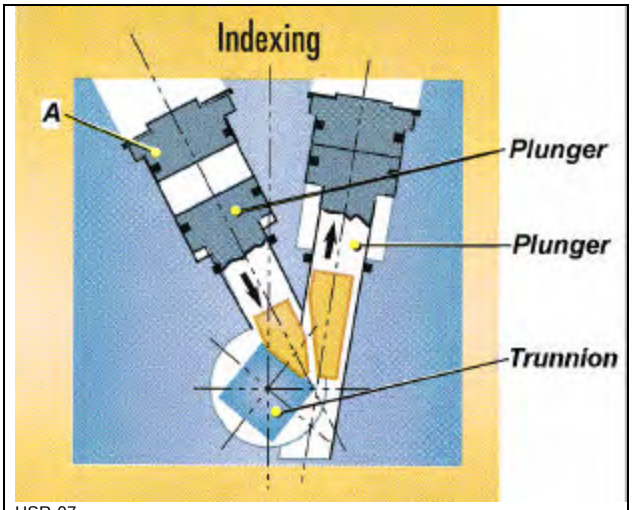
C.: The Hydraulic Power Unit

Periodically check the "dirt alarm" on the filter and replace the filter element when necessary. We supply two replacement filter elements with each power unit. Additional elements can be obtained from Erickson Tool Company or local suppliers.
At least once each year or every 4000 operating hours, the reservoir, suction strainer, and air vent filter should be cleaned at this time check the entire system for possible future difficulties.
* Molykote G is a product of the Alpha-Molykote Corporation of Stamford, Connecticut. This lubricant is available from local distributors all over the United States.



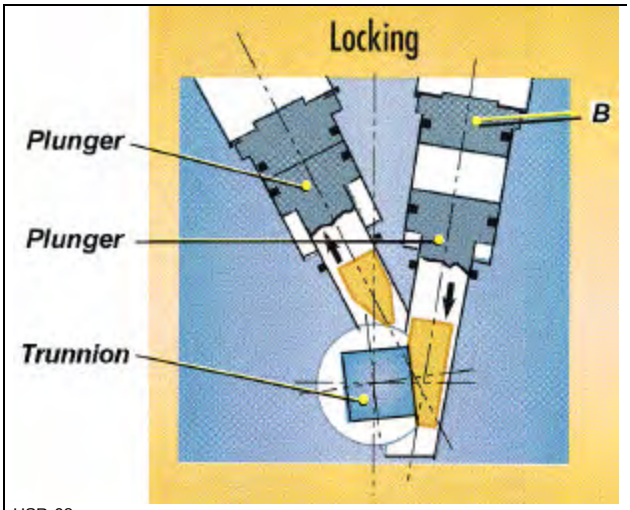
HSR06

Indexing – Locking



HSR 07

The indexing motion is initialized by the hydraulic plunger (A). As the plunger makes contact, the index spindle is rotated a portion of the 90-degree index. Plunger A then retracts.



HSR 08

When hydraulic plunger A retracts, plunger B is actuated. Its motion completes the index and its position, relative to the index spindle, creates a positive lock, holding the workpiece rigidly when turning forces are applied.

A: Chuck Type HSR (T)

The clarnping and indexing is effected through a hydraulic operated piston in the chuck body. Two clamping inserts, contoured to correspond to the workpiece, hold the workpiece. One clamping insert sits firmly on a trunnion, which is housed in a needle bearing, and which executes the indexing movement, and the other clamping insert sits on a clamping piston in the direction of the indexing axis. Two plungers, operating hydraulically in opposite directions, effect the switching and the inter- locking of the square (three – edged) trunnion (fig. 2). Differences in thickness of the workpiece blanks from various deliveries are compensated through shims between the clamping inserts and the trunnion on the indexing side. The chuck body is from nitrated steel, is glasshard, and ground on all precision determining surfaces. All internal parts from alloyed steel are, likewise, hardened and ground. As a result, the indexing chuck is ideal for heavy duty. The only wearing parts, for lack of space, are the needle bearings, which are, however, cheap and quickly interchangeable.

B: The Hydraulic Feed SBHSRS

Five hydraulic hoses provide the hydraulic feed from the control block to the stationary housing built-in at the rear end of the machine spindle. From the trunnion of this hydraulic feed, rotating with the spindle, five straight tubes go through the spindle bore to the chuck. Oil leaks from the chuck and the oil feed are fed back through the transparent oil leak hoses to the hydraulic unit, where every excessive leak is immediately visible.

C: The Solenoid Control Unit

This solenoid control unit can be supplied individually in the case that a hydraulic Power Unit with a hydraulic pressure of at least 45 bar and sufficient capacity is available on the machine. The unit is a complete hydraulic control for clamping or, resp. releasing, and for the indexing (switching) with two four – way - solenoid - valves for indexing (MV1) and for clamping (MV2). The solenoid control unit STHSRN 10 is additionally equipped with an acknowledgement cylinder, a safety valve system, and a limit switch. The valves and their solenoids are easily interchangeable. With every solenoid control unit, we supply a complete set of pressure hoses and transparent oil leak hoses in working order for connection to the oil feed.

D: The Clamping Pressure Control and Safety Unit (included in HAHSR)

This control unit is in addition to the aforementioned solenoid control unit. It serves to control the clamping pressure with an accumulator, which, in case of hydraulic breakdown, holds the workpiece further clamped.

E: The Hydraulic Unit HAHSR 10

The hydraulic unit is completely equipped with oil tank, motor, vane pump, accumulator, pressure switches, as well as a terminal box with wiring, and a complete set of pressure and oil leak hoses in working order. The control block is mounted as a unit on the hydraulic unit, and contains the complete hydraulic control for the clamping or, resp., releasing, and for the indexing (switching).with two four – way - solenoid - valves for indexing (MV1) and for clamping (MV2). The control block is additionally equipped with an acknowledgement cylinder, a safety valve systern, and a limit switch. The valves and their solenoids are easily interchangeable.

Starting up and Maintenance:

Delivery of the hydraulic power pack is effected without oil-filling. Before filling-up with oil, the interior of the oil-tank must be thoroughly inspected for cleanliness. Contamination as, for example, chips and shavings, condensate, etc., can imperil the function of the unit. The connecting hoses between the power pack and the machine should be laid along the shortest route and free from vibration, sharp bends and contusions.
After filling the oil-tank as far as the upper marking on the oil-level indicator, the oil-filling socket must be firmly sealed. Please observe the voltage and frequency data given an the electrical devices during connecting-up.
Accumulators must be filled precisely in accordance with the specifications of the manufacturers. The complete hydraulic installation must be carefully checked, and the screwed joints firmly retightened.
By intermittent switching ON and OFF of the electric motor, the right rotary direction of the hydraulic pump (see arrow on the name-plate of the pump) must be established.
Firstly, the complete hydraulic system should be thoroughly dearated. To this end, it is recommended to loosen the pipe system at the highest point. The hydraulic system must then be so long dearated until the appearance of bubbles and froth-free oil is observed. After the complete system has been filled with oil, the oil-level must again be checked, and the eventual loss of oil supplemented. During this procedure, please observe that, with cylinders having different diameters, time-to-time, larger quantities of oil flow back into the oil-tank than the quantities consumed.
Secondly, adjustment of the pressure on the pump must be undertaken. During operation of the power pack, the oil-level should not fall below the lower marking of the oil-level indicator as, otherwise, the pump can, in certain circumstances, suck-in air.
Should the formation of froth be established in the oil-level indicator, this is an indication that air has infiltrated into the oil circulation. In this case, please switch OFF the hydraulic power pack, and repair the trouble. Sucking-in of air through the pump can, as well, be established through the extreme development of noise in the system.
Infiltration of air and contamination into the hydraulic circulation impair the function and serviceable life of the devices. For this reason, the filters should be regularly-checked at periodic intervals for contamination through abrasion and wear and tear, and, if necessery, these cleaned or, respectively. the filter elements interchanged.
Every oil is subject to an ageing process. Dependent on the operating conditions, we recommend changing of oil after approximately every 1500 to 2500 operating hours, and, thereby, a.fundamental cleaning of the installation. In continuous operation, the oil temperature should not exceed 60^{o}C, otherwise a coolant device must be provided. Please remenber that, through vibrations incurred during operations, the screwed-joints can loosen themselves, and, for this reason, it is recommended that, after approximately the first 20 operating hours, these should be, from time-to-time, retightened.

In consideration of the circumstances dealing with the foregoing special information, it is certain that the starting-up and the maintenance of the hydraulic installation will cause you no problems. Should you, nevertheless, encounter any difficulties, we shall be glad to help you with word and deed. Only with consideration to all the foregoing points, can a satisfactory operation of the hydraulic installation be guaranteed.

Cleaning Cover

The tank has a narrow-side disposed cleaning orifice. The size of the orifice is so dimensioned as to facilitate accessibility at all times to the interior of the tank for purposes of cleaning.
This orifice is locked by means of an aluminium cover and cross- piece with only one srew in the middle. The cover is sealed with an 0-ring pressed against the tank wall.

Oil - filling Socket

The oil-filling socket simultaneously serves to deaerate the oil tank. The air which infiltrates into the oil tank through an alteration in the oil-level is filtered through an insert in the lock. The strainer is screwed with the tank cover by a rigid insert. The insert also serves as a protection. for the strainer against external damage. A dip-rod, permanently magnetised, firmly holds all magnetic particles. The strainer surface is so dimensioned as to facilitate simple and speedy filling of the tank.

Oil - level Indicator

A sturdy oil-level indicator facilitates easy identification of the oil-level in the upper part of the tank. The sight-glass is deeply embedded, and, thereby, protected against damage. The maximum and minimum oil-levels are marked.

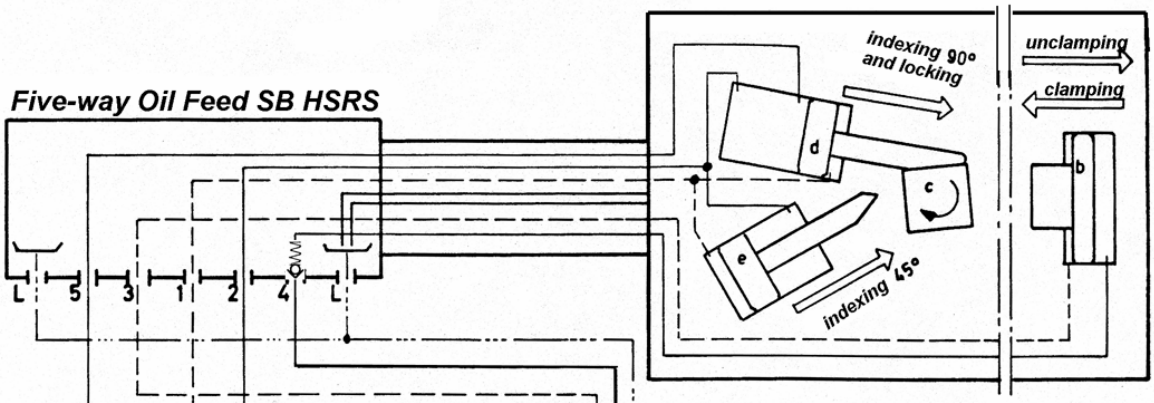
Special Instructions

The accumulator is under continual gas pressure, and should ***not*** be opened!
Furthermore, by no means should attempts be made to fill oil from outside into the accumulator, or to undo the lead seal, or to undertake any other miscellaneous work. Every interruption signifies impairing the service of the accumulator. In the event of any attempts at dismantling the accumulator disqualifies every conceivable claim for reparation.
Before undertaking any dismantling work on the power pack, or, respectively, the hydraulic installation with accumulator, the accumlator, with switched-OFF pump, must be completely ***emptied before loosening*** the first screwed-joint.

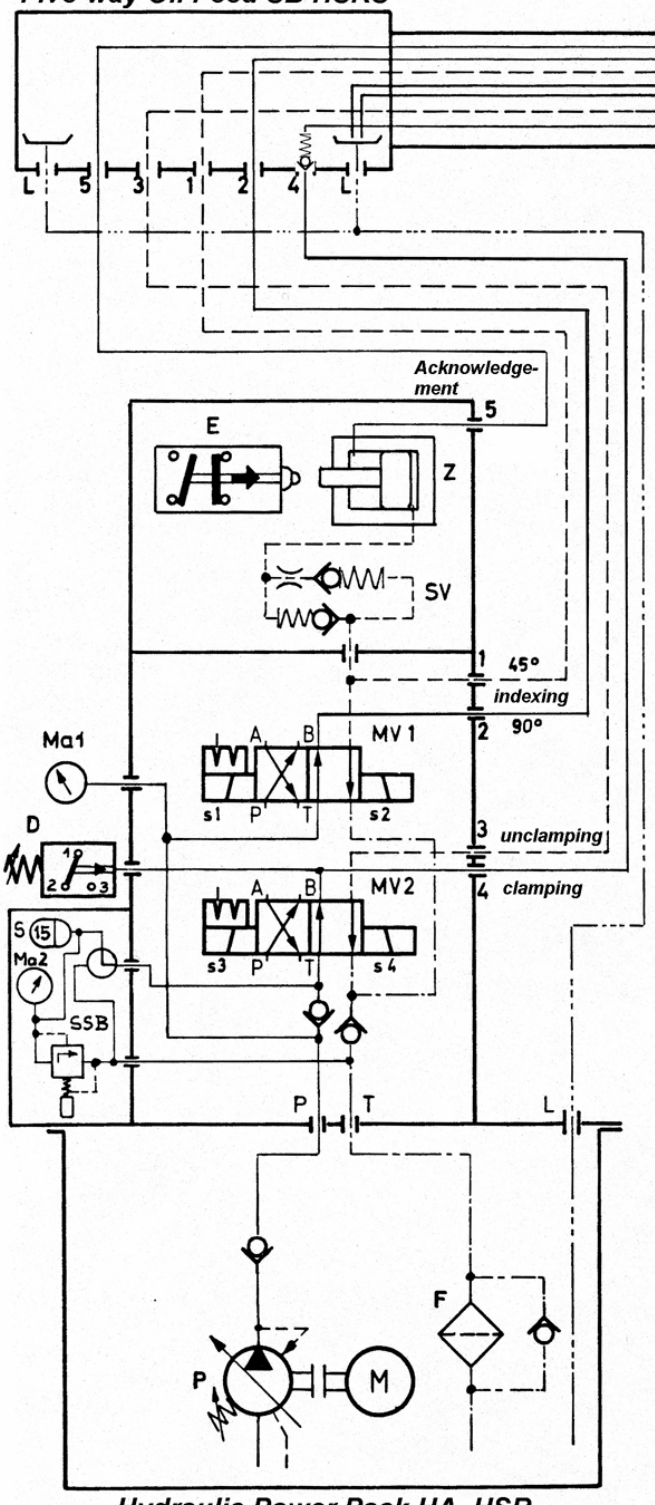
Recommendation for Pressure Fluids

Recommended oil	Operating temperature field	ARAL		BP		Esso		Mobil		Shell	
			Viskosität CSt bei 50°C		Viskosität CSt bei 50°C		Viskosität CSt bei 50°C		Viskosität CSt bei 50°C		Viskosität CSt bei 50°C
25 –54 cSt under operating condition	Heat 60 – 80°C	Aral oil GFY	49,0	Energol HLP 150	49	Esstic 55	49	Mobil D.T.E.Oil Heavy	51	Shell Tellus 137	49,0
		Aral oil TU 524	49,0	Energol HLP 175	65	Teresso56	49			Shell Tellus 537	49,0
		Aral oil TU 528	68,0			Hydraulic oil 49EP	49	Mobil D.T.E. 26	37	Shell Tellus 33	ca. 38
						Nuto H 64	62			Shell Tellus 41	60
										Shell Tellus 141	60

Hydraulic Indexing Chuck HSR



Five-way Oil Feed SB HSRS



M	=	Motor
P	=	Hydraulic pump max. 70 bar
F	=	Return Stroke Filter
S	=	Pressure accumulator
Spa	=	Pressure Accumulator Draincock
Ma 1	=	Pressure - gauge 0-100bar
E	=	Limit switch
Z	=	Cylinder
SV	=	Safety Valve System
D	=	Pressure switch
MV 1	=	4/2 Solenoid Valve for indexing
MV 2	=	4/2 Solenoid Valve for clamping
Ma 2	=	Pressure - gauge 0-250bar
SSB	=	Accumulator Safety System (UVV)

A	pressure oil pipe	———
B	pressure oil pipe	— — —
T	return line	—·—
L	leakage oil	—··—

Initial Position

pump in action
workpiece is clamped
indexing is finished
limit switch starts the machine

Hydraulic Power Pack HA HSR

HSR 09

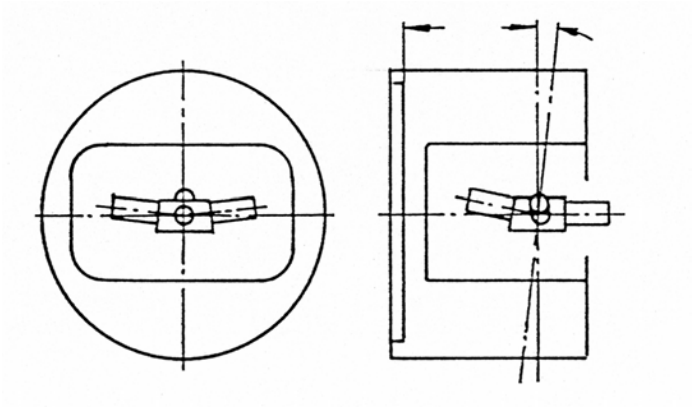
Correction Possibilities:

Optimum indexing accuracies result only when the indexing axis is at right angles to the turning axis.

FORKARDT hydraulic indexing chucks are manufactured with a high precision, which meets most requirements. Should, however, workpieces need to be produced with a higher accuracy, special measures are necessary. The accuracy is determined by three criteria to be considered independently of each other (which can, nevertheless, appear together).

1st. Criterion:

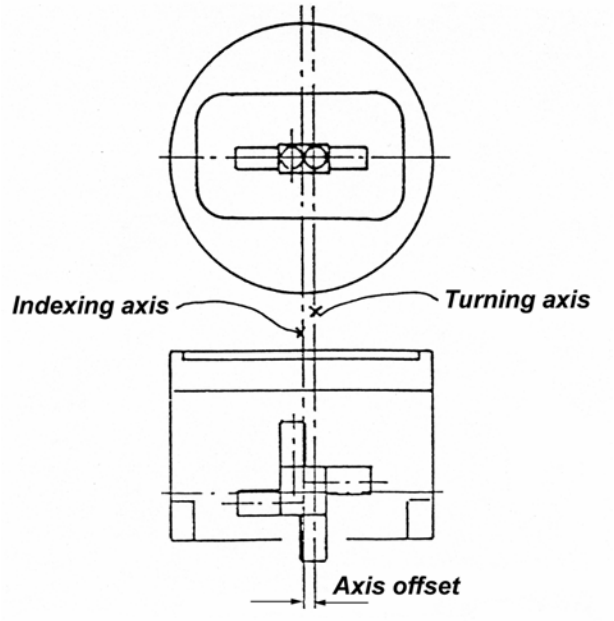
Plane parallelism of the indexing axis to the chuck centering. With an error in the plan parallelism, there is a resultant buckling of the workpiece axes.



HSR 10

2nd. Criterion:

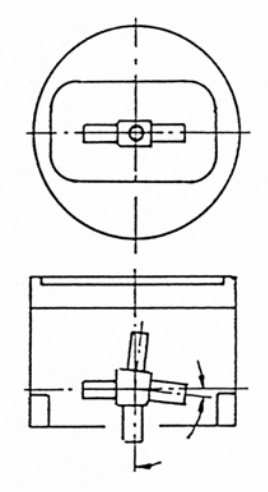
Indexing axis exactly crosses the turning axis. With this error (symmetry offset of the indexing axis to the turni.ng axis), there is a resultant offset of the plane parallelism of the work-piece axes.



HSR 11

3 rd. Criterion:

Angularity (4 x 90^0) on the switch square (with chucks upto 900 dia.) or indexing precision of the Hirth toothing (with chucks from 1000 dia.).
With an error in the angularity, there is a resultant angular deviation of the individual machined sides of the workpiece to each other.



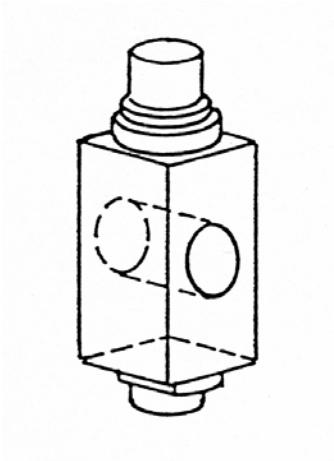
HSR 12

Correction Possibilities:

Re 1.:
With increased precision requirements, the plane parallelism of the indexing axis must be checked on the indexing chuck mounted on the spindle.

The checking of the plane parallelism can be effected with the test workpiece (fig.). Through a mirror reflection of the four surfaces, there is a resultant pyramid, the measured conical from of which gives the error deviation (fig.).

Eventually, the chuck centering plane surface or, as well, the surface on the intermediate flange, must be ground.

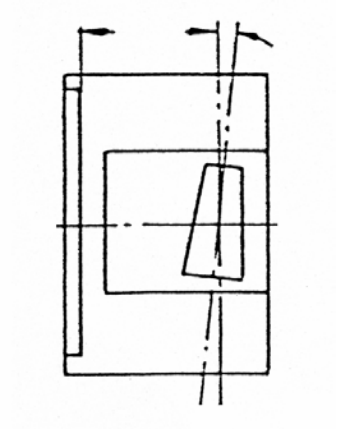


HSR 13

Consideration must, as well, be given to the fact that influences, through centrifugal and chucking forces (beaming of the chuck body), and through one-sided workpiece unbalance, can appear with the various indexing positions.

Furthermore, the accuracy can be increased when, firstly, all roughing operations are executed in one cycle (4 x 90^0, setting the workpiece in the chuck inserts), and, thereafter, the finishing operations in the 2nd. cycle.

Through maintaining a possibly uniform (medium) speed with the various fit diameters, the accuracy can be further increased.



HSR 14

Re 2.:
For reasons that a possible middle offset from the indexing axis to the true turning axis on individual indexing chucks is not controllable, but that the actual deviation can be determined first on the moun-ted chuck by test turning on the specified lathe trough comparative measurements, the FORKARDT hydraulic indexing chucks with increased accuracy requirements (180^0 indexing under 0,05 mm axis offset plane parallel) are provided with a special alignment possibility. The alignment possibility mentioned and described hereafter merely requires a "floating" chuck intermediate flange with a quide-slot offset 90^0 to the indexing axis and a test workpiece with a bore.

The Alignment is effected as follows:

The test workpiece is clamped in the indexing chuck secured to the intermediate flange on the machine spindle. With a turning tool, a counterbore is turned in the bore of the test workpiece on the indexing axis. Thereafter, the test workpiece is indexed 180^0, and the previously turned counterbore is controlled with a dial indicator. The measured values indicated are divided by 4, and this value indicates how much the chuck must be laterally moved along the tenon block. The lateral movement is undertaken with an adjusting screw after loosening the chuck securing screws. During movement, care must be taken to determine whether the chuck must be moved to the left or to the right (see sheet 4).
After alignment, the chuck flange can be dowelled to the chuck body so that, with a chuck disassembly (e. g. cleaning or interchanging for a three-jaw chuck) and renewed assembly, the previously aligned value can remain maintained.

Re 3.:
In the event of angularities for the 4 x 90^0 being required below the standard tolerance range, the switch square can be corrected within certain limits through regrinding. With the Hirth toothing, however, a correction is not possible.
Checking of the angularity can, as well, be undertaken with the test workpiece. For this purpose, the mirrored reflection of the four surfaces serve as measurement.

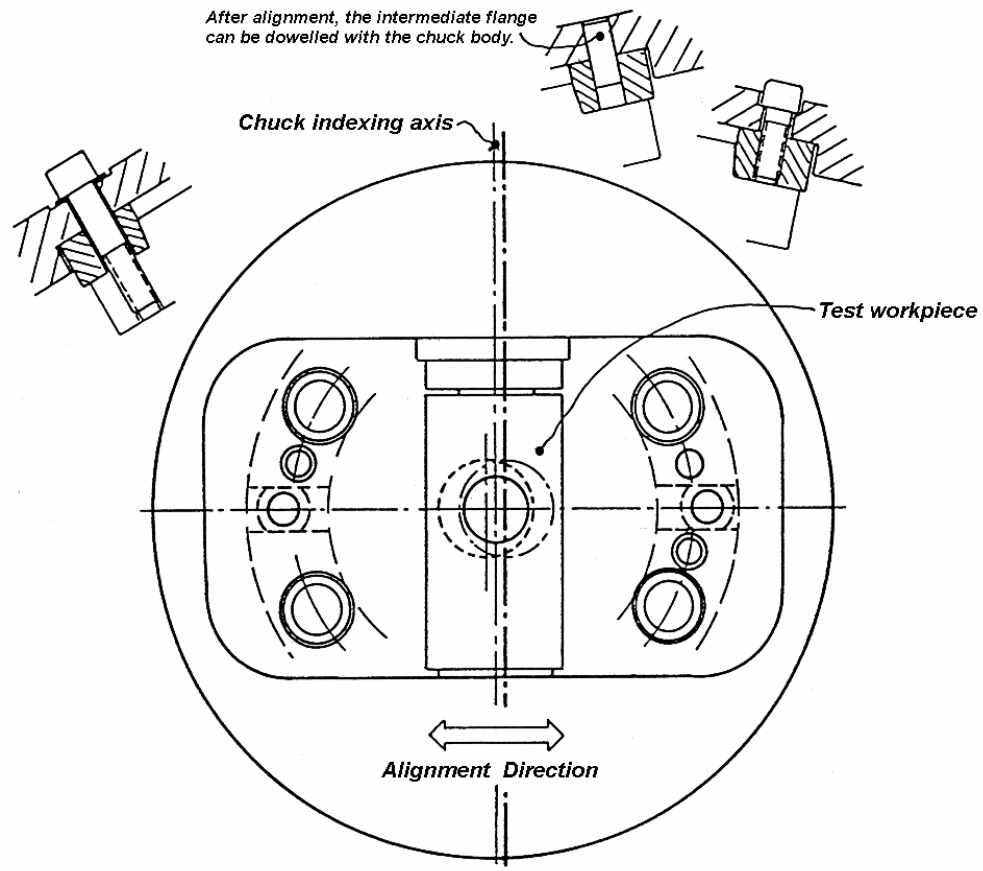
Summing up, it can be said:

Experience has indicated that a correction in the sense of the 2nd. criterion was sufficient for the practice, whereas the corrections according to 1 and 3 were very seldom employed.

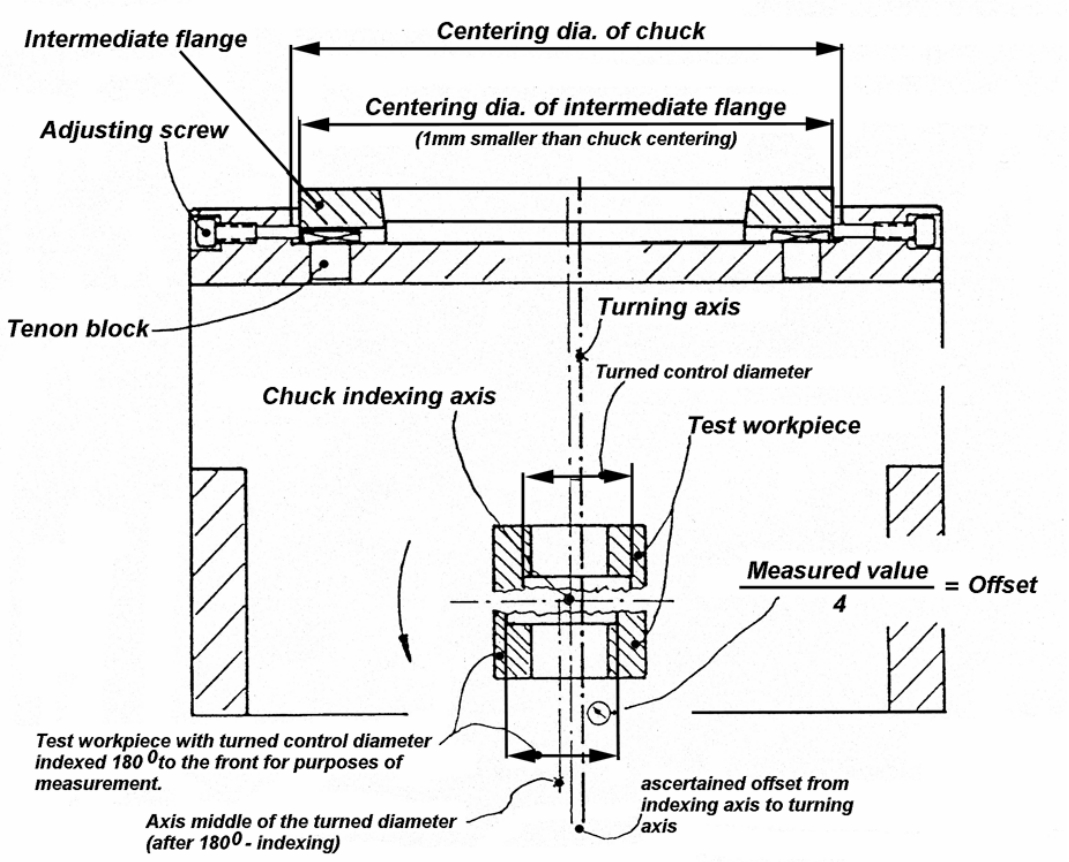
Remarks regarding the Measuring Methods on Finished Workpieces:

For reasons that, under the influences of clamping and centrifugal forces, the hydraulic indexing chuck is subject to deformation, measurement of finished workpieces in the chuck is not permissible. With the measuring methods on finished workpieces (especially with pivot joints and universal joints), consideration is to be given to the influences described under "RE 1", so that, with the error search, no inapplicable conclusions are drawn.

Should oval bores result on the workpiece (e. g. valve bodies), the clamping force is too large. Upon release, the previously turned bores become oval.
Should geometrically untrue trunnions result on workpieces (e. g. pivot joints) there is a too large unbalance in the region of the spindle and clamping device.


After alignment, the intermediate flange can be dowelled with the chuck body.
Chuck indexing axis
Test workpiece
Alignment Direction

HSR 15


Intermediate flange
Centering dia. of chuck
Centering dia. of intermediate flange
(1mm smaller than chuck centering)
Adjusting screw
Tenon block
Turning axis
Turned control diameter
Chuck indexing axis
Test workpiece
Measured value / 4 = Offset
Test workpiece with turned control diameter indexed 180 0 to the front for purposes of measurement.
ascertained offset from indexing axis to turning axis
Axis middle of the turned diameter (after 180 0 - indexing)

HSR 16

Declaration of incorporation

According to **EC Machinery Directive EC Directive 2006 / 42 / EC**

The manufacturer

FORKARDT GmbH
Lachenhauweg 12
72766 Reutlingen-Mittelstadt

herewith declares the following incomplete machines with the designations:

Type designation: Automatic Indexing Chuck

Type: HSR (T)

- The general health and safety requirements according to Appendix I of the aforementioned directive have been referred to and observed.
- The special technical documents according to Appendix VII B have been prepared.
- The aforementioned special technical documents will be submitted to the responsible authority as required.
- Commissioning is forbidden until it has been verified that the machine in which the aforementioned machines are to be incorporated comply with the specifications of the machinery directive.
- Responsible for the documentation

Oskar Weinert

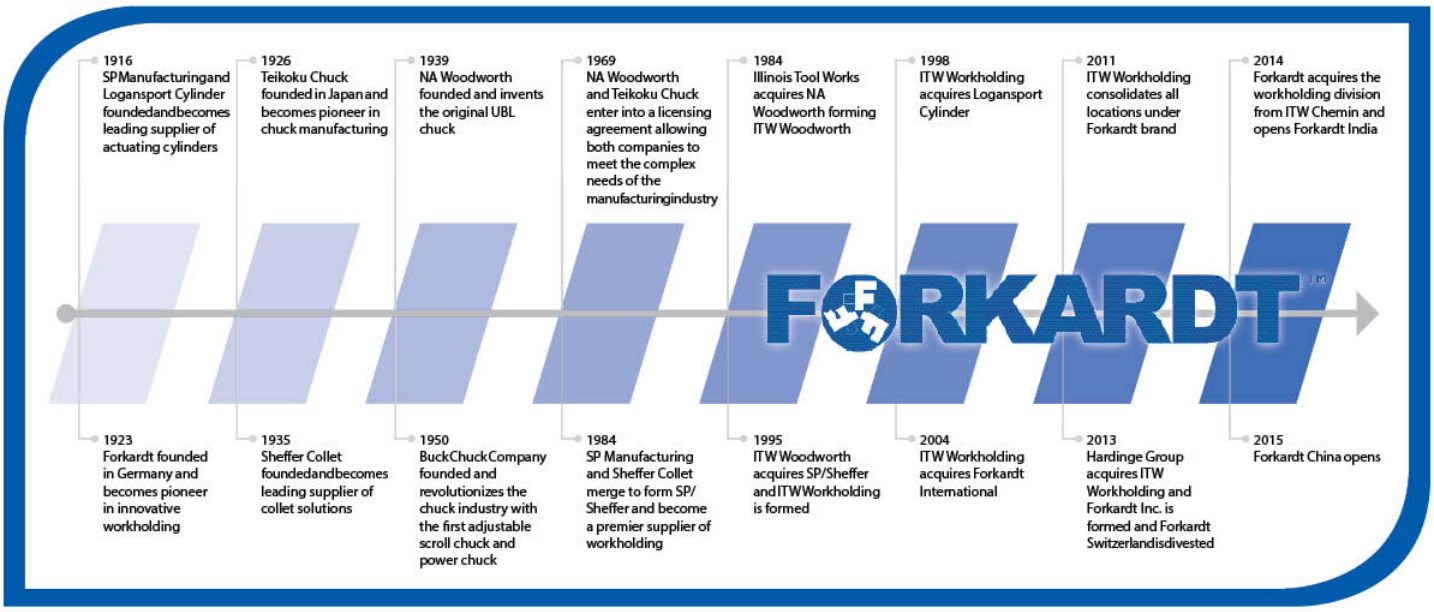
Date/Manufacturer's signature: 28.03.2014

Place: Erkrath

.....
(Head of Design Mr. Weinert)

Company management Declaration of incorporation no.: HSR (T).E

OUR HISTORY



Innovative Technology by FORKARDT

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