Wire harness braiding

Braiding technology and production calculation

Advantages against plastic tubes and tape winding

KBB 1/24-100

KBB 1/32-100

KBB 1/48-100

Special machines

Accessories for braiding machines

Standard harness yarns Engeenred Yarns[™] and Coats[™] August F

Special yarns

Wire braiding

Winding technology



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made in Germany

August Herzog Maschinenfabrik GmbH & Co. KG

- Founded 1861
- Family owned in 5th Generation
- Situated in Oldenburg i. O., Germany
- Market- and technology leader in winding- and braiding machines
- Over 13.000 m² state-of the art production facility
- Over 500 different braiding machines available for different applications
- 140 highly skilled workers







Braiding theory

Braids are textile constructions which yarns cross each other in diagonal direction.

Round braids: Round braids have a round or oval cross section. The products made are cords (general), laces (for clothes), cables (electro) or ropes (heavy braids).





Main specifications of the braid

- a) Cable diameter
- b) Lay length or pitch (Density in Inch)
- c) Used material (yarn type und yarn thickness)

Braid pick





The density can be defined differently:

- a) Picks per engl. Inch (Inch = 25,4 mm)
- b) Picks per french Inch (Inch = 27 mm)
- c) Lay length in mm.

The calculation is as follows:

Example: 24 carrier braid, diameter: 10 mm

Lay length = 31,4 mm 12 Picks = 1 carrier revolution on braiding machine 31,4 mm : 12 carriers = 2,6 mm per pick 25,4 mm : 2,6 mm per Pick = 9,76 picks/ engl. Inch

Main formula for endless braids:

Braid in metres per hour = Lay length x horngear speed x 4×0.06 numbers of carriers

Example: Harness diameter 10 mm, lay length 31,4 mm; used machine KBB 1/24-100; (horn gear speed 250 rpm)

Braid in metres per hour = $31,4 \text{ mm } \times 250 \text{ rpm } \times 4 \times 0,06$ 24 carriers

Braid in metres per hour = 78,5 (without joints and set-up time)

Example harness production:

Harness tree: main arm 3 m length, diameter 15 mm, side arms 6 x 0,5 m, diameter 8 mm.

Production (main arm) = 15 mm x Pi x 250 rpm x 4 x 0,06 / 24 carriersProduction (main arm) = $117,8 \text{ m/h} \rightarrow 3 \text{ m} = 1,5 \text{ mins}$

Production (side arm) = 8 mm x Pi x 250 rpm x 4 x 0,06 / 24 carriers Production (side arm) = $62,83 \text{ m/h} \rightarrow (6 \times 0,5 \text{ m}) = 3,2 \text{ mins}$

Estimated handling time (side arm/ each): 30 sec. per arm Estimated handling time (side arm/total) = 6 arms x 30 sec. = 3,0 mins



Production time = 1,5 mins (main arm) + 3,2 mins (side arms) + 3 mins handling = 7,7 = 8 mins plus set-up time



Product length in relation to yarn length Product length = yarn length on bobbin x sin braiding angle

Example: Shortage factor for the following angles

Product length (35°) = Yarn length x 0,5735 (sin 35°) Product length (45°) = Yarn length x 0,7071 (sin 45°) Product length (55°)= Yarn length x 0,8191 (sin 55°) Product length (65°)= Yarn length x 0,9063 (sin 65°)



Working time with one set of bobbins:

Working time = <u>Yarn length in metres x shortage factor</u> production speed per hour

Example with bobbin with 265 ccm = 237 m yarns 1-ply :

Working time = $\frac{237 \text{ Meter x } 0,7071}{117 \text{ metres per hour}}$

Working time = 1,4 hours

Shortage factor $35^\circ = 0,5735$ Shortage factor $45^\circ = 0,7071$ Shortage factor $55^\circ = 0,8191$ Shortage factor $65^\circ = 0,9063$



Yarn consumption for wire harness cable

Example: Surface of the harness cable set: A = 78 mm²

Surface = Diameter² x Pi / 4 78 mm² = Diameter² x 3,14 / 4 $78 \text{ mm}^2 \text{ x 4}$ = Diameter² 3,14 99,36 mm² = Diameter² **9,96 mm = Diameter**

Yarn length (per lay length) = $\frac{\text{Numbers of carriers x Diameter braid x 3,14}}{\text{Cos braiding angle}}$

Yarn length (per lay length) = $\frac{24 \text{ carriers x } 9,96 \text{ mm x } 3,14}{0,7071}$

Yarn length (per lay length) = 1.061 mm



Yarns consumption per meter harness cable

Calculation (per meter harness cable) = 1.061 mm x 1.000 mm9,96 mm x Pi Calculation (per meter harness cable) = 33.908 mm yarn Calculation (per meter harness cable) = 34 metres yarn

Recommended machine sizes depending of the harness diameter

Numbers of carriers:



Engineered Yarns: Herzog:

HERZOG FLECHTMASCHINEN Patente Ideen seit 1861

Advantages against Plastic tubes and tape winding

Compact machine footprint No cable vibrations Small storage Less storage costs Easy parameter changes possible





Little wire to wire movement **Smaller harness** diameter No fittings required **Easier installation Tamperproof** 100 % occupied **Flame retardant** (MVSS 302, SAE J369 und UL 94)



High assembly costs
Pre cut raw materials
necessary
approx. 30 % space
loss
Vibrations of cables in
plastic hoses
water trap











Abrasion resistant Weatherproof **Colour/ Tracer Temperature tolerant Chemical exposure** No tape/ fittings required **Easy installation** Tamperproof 100 % occupied **Appearance**





Price comparison braiding vs. platic tubes / tapeing

According to customers' experiences there are no price difference between braided harnesses and harnesses with plastic hose covers.





KBB 1/24-100

For wire harnesses between dia. 8 – 20 mm User friendly design Operator panel for left and right handed operators High efficiency, low maintenance required

Suitable for EY cardboard tubes or Herzog flange bobbin 55 x 130 mm





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KBB 1/32-100

For wire harnesses between dia. 16 – 28 mm

User friendly design

Operator panel for left and right handed operators

High efficiency, low maintenance required

Suitable for EY cardboard tubes or Herzog flange bobbin 55 x 130 mm





KBB 1/48-100

For wire harnesses between dia. 25 – 40 mm User friendly design Operator panel for left and right handed operators High efficiency, low maintenance required

Suitable for cardboard tubes or Herzog flange bobbin 55 x 130 mm







Horizontal braiding machine



Horizontal Braiding machine with Siemens PLC and take-off winch for manufacturing of extra long and heavy harnessses for aviation industry.



Patente Ideen seit 1861

Special Braiding Machines

Vertical braiding machine with cylindrical take-off disc, turnable pan, laser- pointer, take-off slides, special carriers with easy carrier exchange system for aviation industry





HERZOG FLECHTMASCHINEN Patente Ideen seit 1861

Accessories





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Hot cutting unit for cutting Polyester fibres.

Enlarged take-off disc for very stiff harness cables.

Accessories

Easy carrier exchange system to exchange carrier upper parts

-> lower down times

-> easy carrier change when using different carrier types







Accessories



Turnable pan for easy loading and unloading of the harness when braiding and extra covering to prevent damaging the harness

Splitted Lexan cover above carriers to avoid harness trees fall into braiding machine made in Germany

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Accessories



PLC- device for repeatable set-up for aviation industry



Slides for easy take-off and handling of the harnesses

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Company Headquarters

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FLECHTMASCHINEN

Available yarn types Engineered Yarns

- VN-4400/VN-4000, Standard PVC coated yarn for conventional harness applications.
- VN-4400S/VN-4000S, High performance PVC coated yarns for applications that require improved chemical resistance and temperature tolerance.
- EY-3023, PVDF coated yarn for applications that require improved abrasion resistance with superior heat and chemical resistance.
- EY-1877, TPE coated yarns for applications that require outstanding abrasion resistance with improved heat and chemical resistance.





	VN-4400	VN-4400S	VN-4000	VN-4000S
Diameter	0.028'' (0.71 mm)	0.28" (0.71 mm)	0.040'' (1.02 mm)	0.040'' (1.02 mm)
Tensile Strength	15 lbs (6.80 kg)	15 lbs (6.80 kg)	22 lbs (9.97 kg)	22 lbs (9.97 kg)
Weight	1000 yds/lbs (2000 m/kg)	1000 yds/lbs (2000 m/kg)	550 yds/lbs (1100 m/kg)	550 yds/lbs (1100 m/kg)



Cemical reaction with typical fluids in construction vehicles

VN-4400VN-4000EY-1877EY-3023 PVC PVC TPE55DPVDF

Battery Acid	1	1	0	0	
Gunk	2	2	0	0	
Motor Oil	1	1	0	0	
Gasoline	1	1	0	0	
Anti-Freeze	0	0	0	0	
Washer Fluid	2	1	0	0	
Hydraulic Fluid	2	2	0	0	
Brake Fluid	2	2	0	0	
Transmission Fluid	2	2	0	0	
Dry Heat Aging					
250 °F/121.1 ℃	3	3	3	1	

0 = no reaction, 5 = heavy reaction (Trial 30 days at room temperature



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Engineered Yarns

Suggested environmental temperatures

VN-4000/VN-4400:

VN-4000S/VN-4400S:

-54° C to 138° C -65° F to 280° F

-40° C to 107° C

-40° F to 225° F

EY-3023:

EY-1877:

-54° C to 150° C -65° F to 302° F

-45° C to 138° C -49° F to 280° F



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Wire processing with braiding machine





Nickel-plated copper Per A-A-59551 Silver-plated copper Per A-A-59551 Tin-plated copper Per A-A-59551 Stainless steel Per QQ-W-423



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Clever Solutions since 1861

Special aviation execution

Special carriers for

- Nomex
- Copper wires
- Silver plated copper wires
- Nickel plated copper wires
- Aluminum wires
- Carrier fast exchange system
- Bobbins 55 x 130 mm or 42 x 130 mm









Winding technology

Higher bobbin capacity with flange bobbins than cardboard tubes.

Less bobbin changes on winding machine.

Cheaper bulk yarn prices.







Winding technology

Winding machine with 4 spindles

Automatic machine stop due to pre select meter counter.

Automatic stop caused by yarn breakage





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Winding technology

Creel for feeding the winding machine Yarn package is under constant tension.

Yarn package will be braked by pneumatic brake system when winding machine stops.

Yarn is permanently braked and controlled





Comparison between papertube and flange bobbin usage

Standard cardboard tube 141 ccm capacity, cross wound Advantage: convenient, ready to use product Disadvantage: more expensive Low volume, high down times



Flange bobbin Herzog 265 ccm capacity, parallel wound

Advantage: less bobbin changes, higher capacity, cheaper yarn price

Disadvantage: Winding machine necessary, extra production step



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