LONGFIELD

Coating Products (Germany) GmbH

A summary of the practical factors governing the use of plain, wire-wound and rolled metering bars to accurately control coating films

Introduction

Longfield was established in 1965 to service the growing needs of a rapidly developing paper industry.

We specialise in the supply of precision-made metering rods to paper mills and substrate converters worldwide.

Considerable stocks of wire and mandrel material enable us to respond quickly to virtually any design requested by our customers.

Our team of experienced engineers carefully monitors each stage of manufacture and every metering bar is examined at least twice under a microscope before its despatch.

This attention to quality has been our hallmark for over 50 years and our customers range from the largest paper mills to small, highly specialised producers of scientific films.

Metering bars are used throughout the paper making and converting world for the accurate control of coating thickness.

They act as wiper blades to remove excess mix from the substrate, leaving an even wet film of high integrity.

Bars are made in *smooth, wire wound and rolled form*, with an optional hard chrome finish to increase longevity and aid cleaning.

Multiple applications

A metering bar is extremely effective in applying solvent-based, hot melt and aqueous coatings to a variety of substrates, including board, paper, film, foil and many textiles.

Wide ranging coating weights

Large wire and mandrel stocks enable users to achieve infinitely variable coat weights and unusually high standards of finish.

Laboratory and Production Testing

Laaboratory bars can be supplied singly or in sets for hand held or machine mounted pre-production testing. Production bars in any diameter and length can also be supplied singly for trial runs.

Full details of Longfield's range of coating bars follow, together with important technical data for Coating Managers.

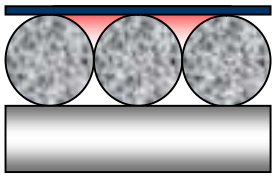
Plain (smoothing) bars

LPB
A plain, unwound bar gives the lowest coating weight and can be supplied in any diameter and length to suit the application

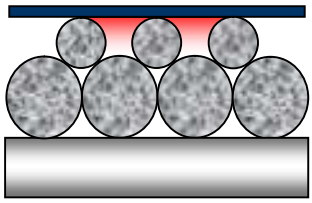
Wire wound (Mayer) bars

Longfield manufactures three types of wire wound bar for the narrow web user:

LSB
A single wound bar for normal use.



LCB
A two wire bar where a smoother, glossier surface is required in a medium coat weight.

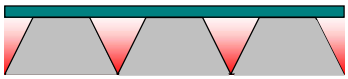


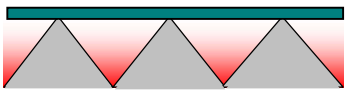
Rolled Bars

Often referred to as grooved bars or, in some countries, as profiled bars, these are manufactured by using purpose-built dies to roll a precisely dimensioned thread into a bar of pre-determined diameter. Rolled bars are generally more rugged than wire wound bars and are preferred by paper mills who use them to apply a size coating to the paper roll.

Objective coat weights are less variable than in the Converting industry but there are a number of different bar diameters and thread profiles that have been standardised by machine makers such as Beloit, Jagenberg and Valmet. The two in most common use are shown below.

Rolled bars can be supplied in any length up to 10 metres and in most profiles.





Top grade materials

Unless otherwise specified, every bar is produced from high quality stainless steel material. AISI 416 (WN 1.4005) and AISI304 (WN 1.4301) are used respectively for wired and rolled mandrels and AISI 316 (WN 1.4401) for the wire.

Coating bar designs

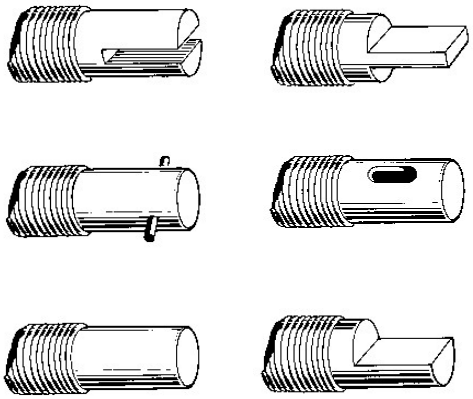
The core diameter of a wire wound coating bar is usually between 4mm and 50mm.

Larger diameters are usually more durable and can be used without supports on account of their greater "beam strength". However, they are more costly and their increased weight

Smaller diameters are more easily managed and will attain their full operating temperature more quickly following a bar change. Their relatively lower cost makes them more popular and they can actually produce better quality finishes with some coating mixes.

Drive ends

There are six basic drive end designs in common use and these are shown below. Additional designs are possible to suit the more specialised applications.



Hard Chromium Plating

Un-plated wire is often preferred for more sensitive applications such as soft, highly polished film. However, a correctly and evenly applied layer of hard chromium at 82 HR or 950-1100 HV can help to protect the wire from accidental damage, facilitate its cleaning after use and ultimately increase its working life by as much as 300%.

Essentially, the integrity of the wire diameter and resultant wet deposit are maintained by carefully controlling the radial thickness of the chromium layer.

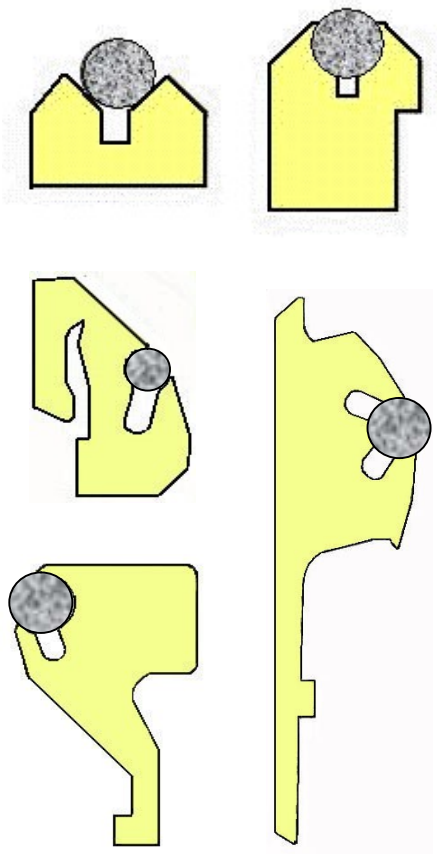
Bar Bearings

There are many different bar bearings utilising various materials ranging from mild steel- (MS) and copper- (CU) based compounds, to polyurethane and PTFE.

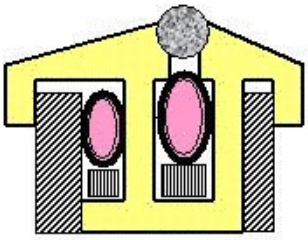
Compared with conventional polyurethane rod beds, machined polyethylene (PE) is less impact resistant but is non-absorbent, can withstand higher working temperatures, provides a smooth start-up and can last up to three times longer due to the far lower coefficient of friction. They are also cheaper to produce and so cost less.

PTFE has the widest range of solvent resistance but is expensive and more difficult to machine.

In terms of bearing design, a simple “V” form will often be sufficient and bars can be changed relatively quickly. Conforming bearings facilitate better cleaning but usually require replacement bars to be fitted from the side. Many bearings employ solvent or water flushing to keep the bar wet. This also serves to dislodge trapped particles or fibres and keeps the coating mix liquid during short stops. Some of the more common designs are shown here.



Pneumatically assisted conforming bar supports are more expensive to produce but last longer and can therefore be more cost effective



System installation

Nearly all coating stations consist of an applicator stage, followed by a metering stage. The applicator can be a simple applicator roll, reverse roll, fountain jet or even immersion bath.

Some systems use the metering bar to apply the coating mix to a covered roll, which then transfers it to the web. This system can be applied to the size press but, in cases where the web is fragile or not fully formed, it can also be used to transfer the mix to a filtering medium.

Surplus mix removed at the metering bar is returned to the reservoir, where continuous filtration (see page 7) will remove foreign particles and coarse aggregates from the mix prior to its re-use.

The metering bar is normally rotated slowly against the web direction to produce even wear and facilitate the removal of trapped fibres. The circumferential rotation of a precision engineered bar can equal the web speed in some installations, while other users favour a ratio such as 50mpm : 1rpm; 300mpm : 10rpm; 600mpm : 20rpm and so on.

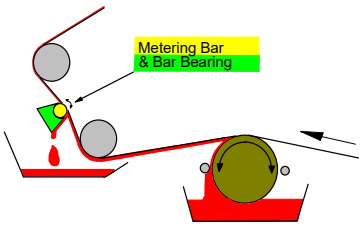
At high web speeds, a low pressure air knife can be employed to flatten the coat without loss of volume after it leaves the metering bar. This system has distinct advantages over the high-pressure knife, which, at higher speeds, gives rise to spray problems. An ideal application would be non-permeable barrier coatings to plastic film for food packaging.

Positioning the metering bar

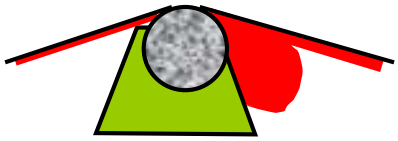
The bar is normally positioned below a horizontal web but there can be advantages in other configurations.

A bar supported only at the ends is the simplest system. However, the bar must have sufficient section to resist deflection and it is only able to rotate with the web.

Positioning the bar at the end of a machine as shown here allows easier access to the bar and it's bearing.

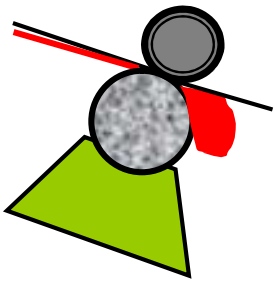


A fully supported metering bar will be wiped along it's entire length, thus enabling it to be rotated in either direction.



Control Rolls

Control rolls need to be as close to the metering bar as possible to ensure an even feed and uniform web tension across the bar. Many installations utilise distances of 120-200 mm and some employ an additional flotation roll to facilitate further adjustment of the bar pressure without disturbing web tension or wrap angle.



Multi-bar coating

Bars are generally used singly but coating heads with two or more bars are also in commercial use, the advantages being in terms of improved coating quality, greater flexibility, rapid trial runs and faster flying changes.

Durability

Base material quality, operator skill, chrome plating uniformity and final inspection expertise dictate a coating bar's performance and one that has been correctly made will last longer than one with inherent faults. However, a more common cause of premature failure is a build-up of solids between the wire turns, which the operator is unable to remove.

For this reason, most of the larger, on-machine coating heads incorporate water-flushed bearings that rotate continuously, even during temporary machine stops. Most off-machine users simply keep the bar in a container of water or a suitable solvent until no longer required.

The life of a bar will also be dictated by the harshness of the coating mix, web pressure and speed, as well as by the condition of any supporting machinery.

Formulations

It is not intended to cover this increasingly challenging aspect of the coating business in any detail. However, recognising the key importance of viscosity and dilatent flow, those users who stock a range of metering bars are often able to eliminate the need to modify their formulations by simply changing the wire diameter.

Hot Melt coating

In hot melt applications, bars may be used to produce a ridge pattern *or* flat film, depending on the temperature achieved and the use (or not) of a chill-roll.

Edge doctoring

This is often achieved by doctoring the applicator roll to restrict the width of un-metered coating mix presented to the metering bar. Bars with restricted length windings can be used and, on off-machine coaters, a piece of thin film can be inserted between the web and the metering bar.

Filtration and de-aeration

Unlike the blade system, wire wound metering bars are generally self-cleaning. However, particles can become trapped and straining or filtration can help to eliminate this. Most systems do not use in-line conditioning but continuous treatment of the coating mix is always advisable and is essential for high-grade coatings such as those used in photo-sensitisation or colour filtration. In solvent coating, a filter press is considered beneficial.

Accurate and inexpensive

The ability of the metering bar to operate in conjunction with web speeds of 1000 to 1500 metres per minute is one reason for its increasing popularity. Bar coaters are also enjoying greater recognition at the size press because of an increasing need to monitor the weight of the mix and reduce the amount flung into the air.

As a consumable item, it is relatively inexpensive and results in a lower cost per tonne of product. Its accuracy, range and simplicity make it an extremely viable method of metering wet thickness, both by the largest and most modern paper making machines, as well as those with very specialised, short run applications and demanding technical requirements.

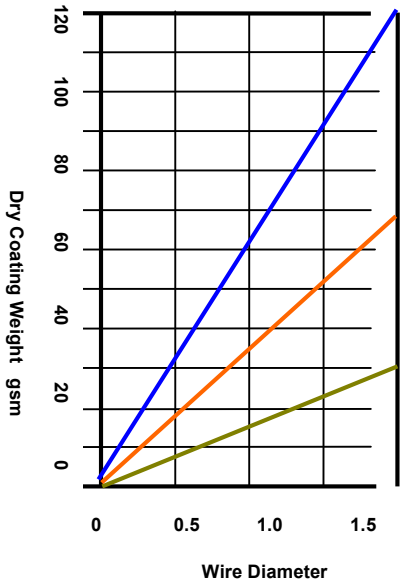
Calculating coat weights (wired bars)

For wire wound (Mayer) bars, there is a linear relationship between the wire diameter and the wet thickness it puts down. Part of our range is shown on page 8 but, from the following example, it can be seen that a wire of 0.41mm will deposit a wet thickness of just over 10% of its diameter.

Objective wet coat weight 20g / m^2
Solids content 45% or 450g / litre

Wet volume = 20 / 450 = 0.044 litres / $metre^2$
Therefore, wet thickness = 0.044mm
*Required wire diameter = 0.044 * 9.30 = 0.41mm*

The dry coat weight is directly proportional to the wet thickness and the dry solids of a given volume of mix will determine the dry weight from any given wet thickness.



Calculating coat weights (rolled bars)

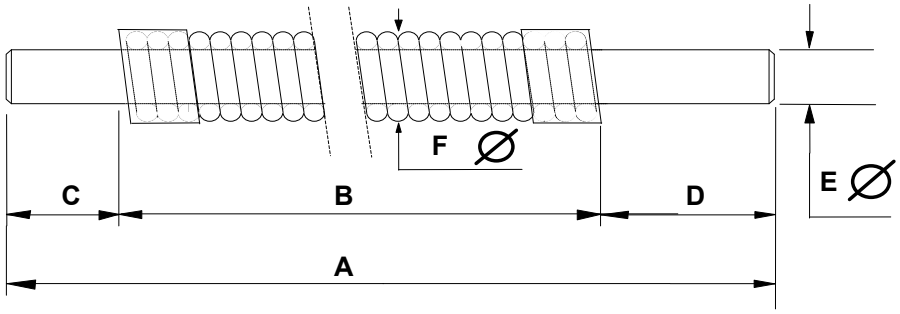
Calculation of the volume and resulting wet thickness from a rolled bar is more complicated and depends on the pitch, depth and form of the thread being rolled.

Most current paper mill users will have arrived at their objective coating weight long ago and those needs will rarely change. Converters will usually have a specific and changing requirement for each product and their needs can only be realised
through a series of laboratory or on-machine experiments using Mayer bars.

Table 1.

Part of the range of Longfield winding types, wire diameters and theoretical wet thicknesses. For specific requirements not shown here, please contact us.

LSB Pitch Turns / CM	LSB Wet Thickness	LSB Wire Diameter	LCB Wet Thickness	LCB Wire Diameter	LTB Wet Thickness	LTB Wire Diameter
100.00	0.011	0.100	0.027	0.255	0.175	1.630
90.909	0.012	0.110	0.029	0.269	0.177	1.650
83.333	0.013	0.120	0.032	0.297	0.179	1.670
78.740	0.014	0.127	0.034	0.318	0.181	1.690
71.429	0.015	0.140	0.040	0.371	0.184	1.720
66.667	0.016	0.150	0.041	0.386	0.188	1.750
57.143	0.019	0.175	0.046	0.424	0.191	1.780
59.945	0.020	0.182	0.050	0.469	0.199	1.850
50.000	0.022	0.200	0.057	0.530	0.201	1.880
45.249	0.024	0.221	0.058	0.539	0.205	1.910
40.000	0.027	0.250	0.062	0.573	0.208	1.940
39.370	0.028	0.254	0.063	0.583	0.212	1.970
37.037	0.029	0.270	0.068	0.636	0.215	2.000
36.364	0.030	0.275	0.070	0.647	0.218	2.030
33.333	0.032	0.300	0.074	0.689	0.220	2.050
32.787	0.033	0.305	0.075	0.700	0.221	2.060
30.769	0.035	0.325	0.078	0.728	0.228	2.130
30.303	0.036	0.330	0.080	0.742	0.232	2.160
29.155	0.037	0.343	0.084	0.785	0.242	2.250
28.571	0.038	0.350	0.087	0.808	0.255	2.380
27.027	0.040	0.370	0.088	0.821	0.255	2.380
26.247	0.041	0.381	0.090	0.836	0.258	2.400
25.840	0.042	0.387	0.091	0.848	0.259	2.420
25.381	0.042	0.394	0.093	0.861	0.260	2.430
25.000	0.043	0.400	0.103	0.954	0.267	2.490
24.631	0.044	0.406	0.108	1.007	0.268	2.500
22.222	0.048	0.450	0.109	1.018	0.273	2.540
21.053	0.051	0.475	0.110	1.024	0.282	2.630
20.833	0.052	0.480	0.111	1.029	0.286	2.670
20.704	0.052	0.483	0.114	1.056	0.295	2.750
20.619	0.053	0.485	0.114	1.061	0.300	2.790
20.080	0.054	0.498	0.120	1.114	0.306	2.850
20.000	0.055	0.500	0.125	1.167	0.309	2.880
19.048	0.056	0.525	0.127	1.184	0.314	2.920
18.182	0.059	0.550	0.130	1.209	0.322	3.000
17.921	0.060	0.558	0.131	1.220	0.327	3.050
17.544	0.061	0.570	0.137	1.273	0.336	3.130
17.391	0.062	0.575	0.143	1.326	0.341	3.180
16.667	0.065	0.600	0.145	1.347	0.349	3.250
16.000	0.067	0.625	0.148	1.379	0.354	3.300
15.748	0.068	0.635	0.150	1.400	0.357	3.330
15.385	0.070	0.650	0.152	1.410	0.362	3.380
15.152	0.071	0.660	0.154	1.432	0.368	3.430
15.038	0.072	0.665	0.160	1.485	0.376	3.500
14.815	0.073	0.675	0.162	1.508	0.382	3.560
14.286	0.075	0.700	0.165	1.538	0.389	3.630
14.065	0.076	0.711	0.168	1.563	0.396	3.690
13.793	0.078	0.725	0.171	1.591	0.403	3.750
13.569	0.079	0.737	0.174	1.616	0.409	3.810
13.333	0.081	0.750	0.182	1.697	0.429	4.000
13.123	0.082	0.762	0.188	1.750	0.443	4.130
12.500	0.086	0.800	0.194	1.803	0.456	4.250
12.121	0.089	0.825	0.200	1.856	0.470	4.380
11.765	0.091	0.850	0.205	1.909	0.483	4.500
11.429	0.094	0.875	0.211	1.962	0.497	4.630
11.111	0.097	0.900	0.222	2.068	0.510	4.750
10.811	0.099	0.925	0.228	2.121	0.523	4.880
10.256	0.105	0.975	0.274	2.545	0.537	5.000
10.000	0.108	1.000	0.285	2.651	0.591	5.500
08.333	0.129	1.200	0.296	2.757	0.644	6.000
08.000	0.134	1.250	0.308	2.863	0.671	6.250
07.692	0.140	1.300	0.319	2.969	0.698	6.500
07.407	0.145	1.350	0.342	3.182	0.725	6.750
07.143	0.151	1.400	0.365	3.394	0.752	7.000
06.667	0.161	*1.500*	0.388	3.606	0.805	7.510
06.250	0.172	*1.600*	0.410	3.818	0.859	8.010
05.882	0.183	*1.700*	0.433	4.030	0.915	8.510
05.556	0.194	*1.800*	0.456	4.243	0.968	9.010



A Overall Length	B Wound Length	C Left End *	D Right End *	E Bar Diameter	F Overall Diameter
mm/inch	mm/inch	mm/inch	mm/inch	mm/inch	mm/inch

Bar Material? *Normally AISI416 WS 1.4005*

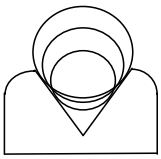
Wire Material? *Normally AISI316 WS 1.4401*

Chrome Plated Wire? ***Yes No***

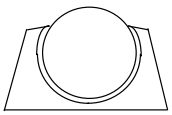
Special Ends? Give dimensions, or provide drawings where appropriate

Winding Type? *	Wire Diameter?	Quantity?	Winding Type? *	Wire Diameter?	Quantity?	Winding Type? *	Wire Diameter?	Quantity?

*** LSB = Single Wire LCB = Two Wires LTB = Three Wires**



'V' Type Bar Bearing	YES / NO



Conforming Bar Bearing	YES / NO

Will the soldered areas at each end of the winding be clear of the bar support? YES NO

If you would like a quotation, or wish to place an Order, please email sales@longfield-coating.com

QUOTATION / ORDER required by:

Company.....
Telephone No: ..... email: .....
Contact / Title:..... Date: .....

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