CONVEYOR IDLERS – SANS 1313 and SELECTION PROCEDURES

Adriano Frittella and Simon Curry

1 INTRODUCTION

Conveyor idlers are generally considered a consumable element of the conveyor. Their unit value is relatively low when compared to the price of a pulley, plummer blocks or the conveyor belting.

However, there are many idlers within a conveyor system. Consider a typical in-plant conveyor, say 250 m long – typically this would comprise 5 pulleys, 250 trough idlers and 80 return idlers, further broken down into 750 trough rolls and 80 return rolls (160 if V return idlers are used).

Considering the possibility of damage resulting from a failed idler roll (increased friction, increased belt cover wear, possibility of fire due to increased friction and the possible catastrophic damage to the most costly piece of equipment, the belt) it is clear that a careful selection of the idler for a specific duty is required.

The failure of an idler roll is dependant on a multitude of factors including the initial specification based on the selection of the roll to suit specific design criteria, the inherent product quality and the accuracy with which its components are manufactured and assembled.

This paper reviews the development of SABS/SANS 1313, identifies in basic format the loads applicable to idlers and defines the criteria used to select the idlers based on the identified maximum load conditions. It then relates this to available selection standards and introduces the latest revisions to SANS 1313, undertaken to ensure that the standard retains its relevance and high regard in the idler industry.

Within the paper the SANS 1313 definitions are used, in particular the idler is defined as the complement of roll and base. This is just to differentiate from the common identification of a roll as an idler.

2 HISTORY OF SANS 1313

2.1 SABS 1313 - 1980

In the early 1970's a group of South African idler manufacturers and end users began the long process of establishing an idler standard.

One of the major problems encountered in those days was that the South African market was dominated by idlers whose original design emanated from the USA. A marketing ploy to ensure that subsequent orders for idler rollers were placed with the supplier of the original equipment saw these manufacturers produce idlers with very special adaptors on the rolls ends. These special adaptors were also used as a pre-tensioning mechanism for the taper roller bearings generally used in the manufacture of American idler rollers.

The SABS committee set itself a few criteria, of which the most critical was defined as the ability to fit a roller from any manufacturer into supporting brackets (transoms, bases) produced by any manufacturer. As a further important requirement, the idler mounting centres were to be interchangeable with the existing so that no significant changes to supporting structure were required in adapting to the new standard.

The major standards used at that stage were BS and CEMA and the mounting centres were very similar. So in keeping with the then requirements to metricate, the existing standards were converted to ISO and adopted in SABS 1313.

The committee then proceeded to identify the types of idlers used and defined the major categories on the trough and impact side as:

- Three and five roll.
- In-line and offset.
- Various trough angles.
- Roll height above the support steelwork.
- And on the return side.
- Flat return and Vee return.

Turning their attention to the loading capacity, the committee opted to keep away from the CEMA method of classifying idlers in accordance with a certain load carrying capacity. Instead it was decided to differentiate between different load carrying capacities by specifying the different bearing diameters – hence series 25 - a 25mm diameter bearing. It is noted that at no stage were the different load carrying capacities of bearings of the same inner diameter considered. Therefore it was mainly a definition of shaft diameter at the bearing.

Full definition of the idler was finalised by specifying different roll diameters, belt widths, roller gauge lengths (dimension between the mounting flats) and the form and dimensions of the roll ends.

All dimensions were subject to relatively stringent manufacturing tolerances.

The tubing was specified to conform to specific material requirements, ovality and straightness tolerances (SABS 657 part 3).

The SABS 1313 standard served its purpose in the early, formative years of the South African belt conveying industry.

The growth of the belt conveyor industry was led by the growth in the coal mining sector with the belt conveyor proving itself as the most efficient method of extracting the mined coal from the mine.

Of particular significance was the extensive use of the series 25 idler – this due to the relative ease of availability of the series 25 idler bearing the BBIB4205 (seize resistant or NCB) bearing which, in the days of economic sanctions, was manufactured by SKF in their Port Elizabeth plant.

The use of wider belts requiring the use of higher rated bearings and larger diameter shafts when used in a typical three roll application, made the use of five roll idlers very common for belt widths 1200 mm and wider.

The development of fire resistant belting – solid woven PVC, brought some additional challenges to idler manufacturers. This type of belting is relatively thin and, if used in conjunction with in-line style idlers, often led to the belt being pulled between the idler edges resulting in torn conveyor belting. This led to the preferred use of off-set style idlers.

The time taken to bring the specification to fruition was about 5 years.

2 SABS 1313-1 1993

The significant expansion in the system of power stations in the mid-eighties coupled with increased requirements for coal within both the South African and world markets required longer conveyors operating at higher speeds, and users began to demand better quality idlers. At the same time the expanding market resulted in a proliferation of idler manufacturers. Many of these manufacturers produced idlers (both rolls and bases) of inferior quality and hid behind the saying that the items were produced to SABS 1313. At the time one of the only available differentiating characteristics in SABS 1313 was the TIR (Total Indicated Run-out) – defined as L/600+0.55 – which for a 270 mm face roll (5 roll 1200 mm belt) results in a TIR of 1mm. Comparatively the DIN 22112 standard gave a maximum TIR of 0,5 mm for a 127 mm dia 270 mm face roll.

When coupled to the complete absence of any reference as to how well the roll should rotate, such as break-away mass or running friction, the frustrations of conveyor designers in ensuring the supply of a well designed energy efficient system should be clear.

This period saw major users, specifically AAC (Anglo American Corporation), Eskom and Sasol introduce specific in-house specifications in an attempt to improve the quality of idlers being supplied for use in mining applications.

Examples are AAC's production of specification 373/1 where a revised TIR specification to restrict the TIR when measured close to the roll ends to a maximum of 0.5 mm was introduced. The specification also introduced tolerances on the machining of the shafts and bearing housings.

Sasol, in attempting to reduce their perceived exceptional cost of replacement of idler rolls, created specification SSC001. This specification was generally based on DIN22001, incorporating the requirements for a specific make and type of bearing, and roll performance requirements such as running resistance and tests for efficacy of seals.

All major users restricted the make of bearing to be supplied to either SKF or FAG and many also specified the type of bearing as the SKF seize resistant type (also generally known as the National Coal Board bearing).

Thus the committee (missing many of the original members due to the withdrawal of many companies from the South African market) was reassembled with the primary aim being to improve the standard so as to ensure significant improvements in idler performance and in particular to ensure a good service life for idler rolls.

Hence the advent of SABS1313-1 :1993. This revised specification included the original SABS1313 with its very complete dimensional definitions of various idlers and incorporated idler roll performance specifications mainly adopted from those incorporated in DIN22101. Therefore the new specification stipulated amongst others reduced TIR limits, break-away mass, roll running friction, shaft and bearing housing tolerances and integrity of the roll when subjected to axial loads. Many of the amendments to the specification were based on the performance requirements and test methods detailed in DIN22001.

Note the -1 in the title. At the outset the committee set itself a target of creating a standard for idlers mounted in an under-slung format (i.e. the top of the centre roll lies below the top of the supporting steelwork), and this was to be termed Part 2 (including fixed form suspended or link suspended [garland] idlers).

Part 1 of SABS 1313 1993 took about 6 years to implement with Part 2 taking a further 5 years. In the interim idler manufacturers used SABS 1313 for dimensional requirements and adhered to the various user specifications for performance specifications.

3 SANS 1313 PART 1, PART 2, PART 3 – 2009?

The first variation one notices is the change in nomenclature from SABS (South African Bureau of Standards) to SANS (South African National Standards), this being due to a realignment and creation of different business units within the SABS.

Noticeable is also the inclusion of a Part 3.

So what was missing in order for a designer to specify an idler?

The existing specifications and particularly SABS 1313 Part 1 incorporated only a ‘series’ in differentiating between idlers of different load carrying capacity. The idler series basically specifies the diameter of the shaft at its ends (implying that this equates to the bearing inner diameter).

Calculating the load on the idler and hence the most highly loaded roll carrying capacity within the idler set was left up to the conveyor system designer. The designer would typically select the roll shaft diameter and bearing type to suit the required duty.

An investigation of existing idler standards showed that the idler load rating was specified in CEMA. This allowed the designer to specify a specific idler category to suit the required duty in accordance with the CEMA classification. One small problem was that the CEMA standard was not readily available in the old highly sanctioned South African market.

The idler committee was again called together, this time to update the standard to incorporate a method to allow for the selection of idlers to suit specific duties. The committee decided to amend the standard by creating a Part 3 which would include the performance criteria and testing methods previously incorporated in Part 1 as well as a duty based selection method.

The development of Part 3 has been a continuing project since 2004 and it is hoped that it will be concluded in 2009.

3 THE BASIS FOR IDLER DESIGN

Prior to discussing the creation of SANS 1313 Part 3 it is worthwhile to review the factors affecting idler design as well as idler selection criteria.

3.1 IDLER LOADING

The total load on an idler is established from the following factors:

- Burden or material load
- Mass of the belt
- Self mass of the rollers
- Secondary loads such as misalignment loads (tension), loads due to dynamic effects (speed and material dependant) , loads due to belt geometry (curves)

The foregoing are well defined in most conveyor idler catalogues and in CEMA.

3.2 SELECTION CRITERIA

Once the total load on the idler has been calculated the idler may be specified and selected on the basis of the following criteria:

- Roller diameter in terms of belt speed
- Roller bearing types and size
- Shaft diameter
- Idler base materials

3.2.1 Selection Criteria for Idler Rolls

Once the total load on the idler has been calculated the load applicable to individual loads can be calculated by applying a Burden Factor (Burden Factor is the proportion carried by the most highly loaded roll) to the total load to obtain the individual roller loads. Typical burden factors on 3 roll trough idlers is 0.7, i.e 70% of the total load is carried on the centre roll. The Burden Factor is dependant on the idler type, trough angle, the material characteristics and on the belt fill ratio.

Having calculated the load on the most highly loaded roll the roll, is selected on the basis of three criteria

- Bearing life
- Shaft deflection
- Shaft bending stress

The bearing life and shaft deflection criteria are somewhat interdependent in that the formula for calculating bearing life is only applicable in cases where the alignment between the inner and outer cages (equivalent to the generically termed ‘shaft deflection’) remains within pre-defined limits.

Typical values for these selection criteria are:

- Bearing life (as calculated using the L10 formula) between 30,000 hours and 60,000 hours.
- Shaft deflection dependant on bearing type. Typical values for deep groove ball bearings are between 6-15 minutes of arc, highly dependant on the type of cage material used. Typical values for taper roller bearings are between 2-6 minutes of arc dependant on the geometry of the rolling elements.
- Shaft bending stress of 110 MPa.

The values quoted for shaft deflection are the maximum allowable bearing value onto which it is practical to allow the idler manufacturer some lee-way for manufacturing inaccuracies – hence typically the limits for deep groove ball bearings are set at between 5-10 minutes, again dependant largely on the bearing cage construction.

The foregoing illustrates one of the major disadvantages of the use of taper roller bearings, in that under conditions of heavy load the significantly higher load rating (when compared to a deep groove bearing) is reduced exponentially by the effect of misalignment of the bearing components.

3.2.2 Selection Criteria for Idler Bases

Having calculated the total load on the idler, the main load carrying member of the idler base (typically a rolled steel angle section) is selected on the basis of the following typical criteria:

- Maximum bending stress – dependant on type of construction – typically 100MPa – 165MPa.
- Maximum deflection at centre of 1/360 of the mounting centres but limited to 5mm maximum

4 IDLER LOAD RATINGS

A search of available standards shows that the only standard where an idler is defined by its load carrying capacity is CEMA (Conveyor Equipment Manufacturers' Association of the USA).

Within the other large conveyor supplier/user markets, Europe, Australia, Japan and China, idler catalogues and engineering general practices are used to select the idler for a specific duty.

4 CEMA LOAD RATINGS

The CEMA idler load ratings define the idler class which is capable of withstanding a certain duty.

The total load on the idler is calculated on the basis of the same factors as defined in 3.1 (CEMA gives a detailed routine on this calculation).

This load is then compared to a loading against different classes of idlers. CEMA B,C,D,E and F (CEMA A was eliminated in the latest version of CEMA). This classification is modified to include a roll diameter which is selected on the basis of belt speed.

Hence, remembering that CEMA is still not metricated, a typical CEMA idler would be CEMA C6. This means that the selected idler would be capable of withstanding the loading for the selected belt width as specified in the CEMA C table and that the roll diameter would be 6" (six inch) or 152 mm in metric terms.

Typical CEMA load rating tables are illustrated below. Note the surprising dependence on idler trough angle – this is suitable if the full conveyor length is equipped with idlers of a specific trough angle – but what happens when the 20 degree trough is used as a transition zone idler? Would this require a different idler to the others?

The other modifier is that the tables are applicable to idlers having rolls rotating at 500 rpm and with calculated bearing life of 30,000 hours in the case of CEMA B and C and 60,000 hours for CEMA D,E and F.

Aside from these factors the designer now has a simple method of specifying the conveyor idler that he requires. Indeed this method has, and continues to be, used in the specification of idlers even locally where CEMA is generally not used.

There is one factor which the CEMA tables does not consider, and this is shaft deflection. In the latest version of CEMA the need to check for compliance to shaft deflection is alluded to but is not clearly defined, nor considered in the idler selection tables.

Table 1 is an extract from CEMA STANDARD 502-2004 and details the idler load ratings for CEMA B, CEMA C and CEMA D idlers. Of note is the variation in bearing life between CEMA B and C and CEMA D as stated above, as well as the variation in loading due to varying angles of troughs.

Load Ratings for CEMA idlers – Rigid base – loads are in lbs						
Idler Class	Belt Width (inches)	Trough Angle			Single Roll Return	Two Roll Vee
		20°	35°	45°		
CEMA B Idlers	18	410	410	410	220	n/a
	24	410	410	410	190	n/a
	30	410	410	410	165	n/a
	36	410	410	396	155	n/a
	42	390	363	351	140	n/a
	48	380	353	342	125	n/a
	Ratings Based on Min L10 of 30,000 hours at 500 rpm					
CEMA C Idlers	18	900	900	900	475	n/a
	24	900	900	900	325	n/a
	30	900	900	900	250	500
	36	900	817	810	200	500
	42	850	791	765	150	500
	48	800	744	720	125	500
	54	750	698	675	*	500
	60	700	650	630	*	500
	66	n/a	n/a	n/a	*	500
	Ratings based on Min L10 of 30,000 hours at 500 rpm '*' use 'CEMA D' Return Idler					
CEMA D Idlers	24	1200	1200	1200	600	n/a
	30	1200	1200	1200	600	n/a
	36	1200	1200	1200	600	850
	42	1200	1200	1200	500	850
	48	1200	1200	1200	425	850
	54	1200	1116	1080	375	850
	60	1150	1070	1035	280	850
	66	n/a	n/a	n/a	215	850
	72	1050	977	945	155	850
	78	n/a	n/a	n/a	125	850
	Ratings based on Min L10 of 50,000 hours at 500 rpm					

Table 1: Extract from CEMA Standard 502-2004 – Idler Load Ratings

Applicable notes are:

1. Troughing Idler Load Ratings are for three equal length rolls.
2. Load Ratings for Trough Idlers also apply to impact idlers.
3. Troughing Idler Load Ratings are based on a load distribution of 70% on centre roll and 15% on each wing roll for all trough angles.

The complete table extends to include CEMA E AND CEMA F idlers as well as PICKING IDLERS and Live Shaft (small pulley as typically used in belt feeders) Idlers.

4 SANS 1313 RATINGS

The CEMA procedure gave the committee an indication of the way forward.
The committee believes that it took the process further by including the shaft deflection criterion within the load rating.

The process followed is as follows:

The bearing life criterion was selected as 40,000h to match the requirements of SANS 1313.
The maximum load to achieve the 40,000h bearing life was calculated for different types of bearings based on the individual bearing Dynamic Load Rating at a roll rotating speed of 750rpm (the limit set by SANS 1313) .

The maximum load to limit the deflection to that specified by the bearing manufacturer (dependant on bearing type and with due cognisance given to manufacturing tolerances) was then calculated. This was applied to all the roll lengths defined in SANS 1313 using a generic roll seal to determine the ‘overhang’ dimension.
The lower of these two values (life and deflection dependant) was then selected as being the roll rating for a specific roll face length.

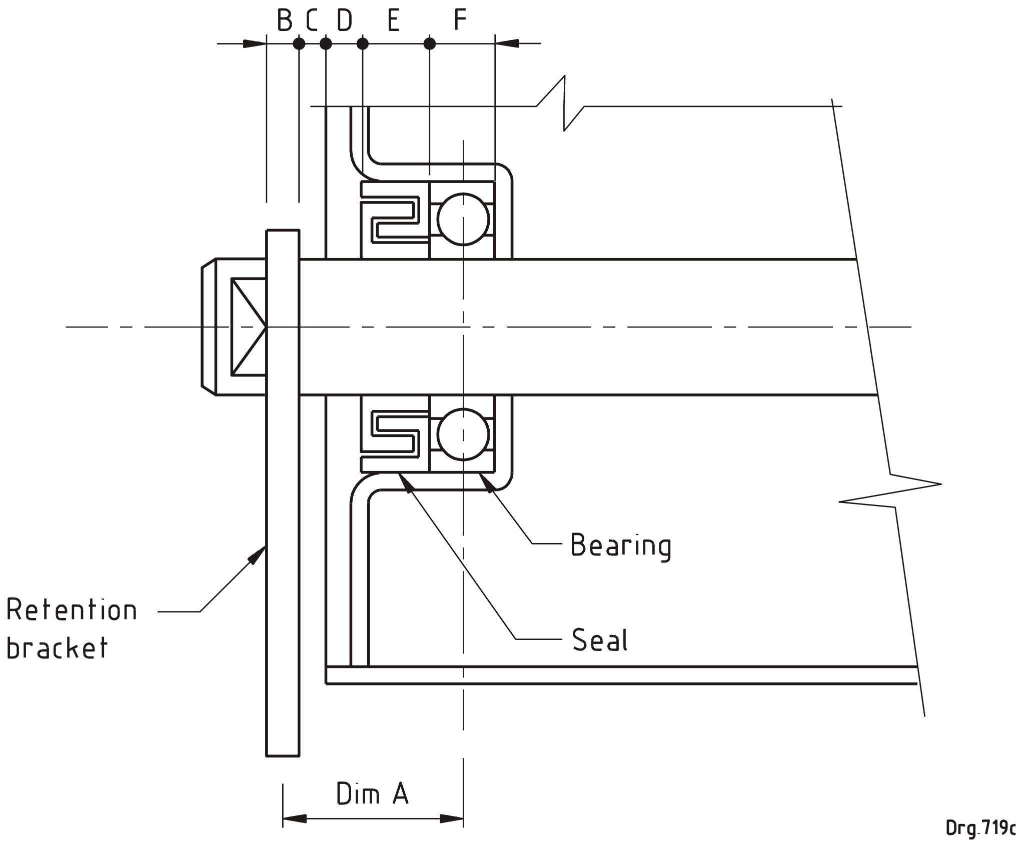

Figure 1: Generic Idler Sealing Arrangement

Where the dimensions in Figure 1 are defined as:

Dim A = (B ÷ 2) + C + D + E + (F ÷ 2)   where:

B = Minimum bracket thickness as per SANS 1313 part 1

C = Clearance as per SANS 1313 inclusive of the 1 mm tolerance per side.

D = Clearance between the end of the roller and the end of the seal. For these calculations this value is assumed as being equal to half the width of the bearing used. The actual dimension should be confirmed by the idler manufacturer.

E = Width of the seal. For these calculations this value is assumed as being equal to the width of the bearing. The actual dimension, for critical applications should be confirmed by the idler manufacturer.

F = Width of the bearing as per ISO.

Following from the above and the abridged data shown in the tables below a series of tables giving the maximum load carrying capacity of a specific roll were created.

BEARING DETAILS									
Bearing reference:	**420204**	**420205**	**6205**	**6206**	**6305**	**6306**	**6307**	**6308**	
Static load rating:	5	11	7.8	11.2	11.6	16	19	24	**kN**
Dynamic load rating:	10.4	12.7	14	19.5	22.5	28.1	33.2	41	**kN**
Revs per minute:	750	750	750	750	750	750	750	750	**RPM**
Required bearing life:	40000	40000	40000	40000	40000	40000	40000	40000	**hrs**
Maximum bearing load in N:	855	1044	1151	1603	1850	2310	2729	3370	**N**
Maximum bearing load in kg:	87	106	117	163	189	235	278	344	**kg**

Table 2: Data Used for Life Criterion

Bearing ref:	**420204**	**420205**	**6205**	**6305**	**6206**	**6306**	**6307**	**6308**	
Allowable bearing deflection to DIN:	14.0	14.0	15.0	15.0	15.0	15.0	15.0	15.0	**min**
Basic allowance for manufacturing inaccuracies	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**min**
Allowable deflection for calculation purposes:	8.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	**min**

Table 3: Data Used For Deflection Criterion

The data displayed in Table 1 and Table 2 was used to create reference idler load tables which allow for the selection of a roller on the basis of satisfying both the life and deflection criteria.

Note that the life criterion is based purely on a maximum roll rotating speed and thus the need to replicate the tables for different roll diameters is not required.

The tables to be presented in SANS 1313 Part 3 will include:

- 3 roll Trough and Impact
- 5 roll Trough and Impact
- 2 Roll V and Flat Return
- Separate tables for 3 and 5 roll link suspended (garland) idlers. This is necessary to account for the larger dim. A normally encountered with this type of roller.

Two typical tables, for 3 roll Trough and Impact and for 2 roll Vee and Flat return are included below.

3 ROLL TROUGHING AND IMPACT									
Belt width:	**Gauge:**	**Allowable load on the centre roller in kg ***							
400	**180**	174	213	235	377	327	471	556	687
450	**200**	174	213	235	377	327	471	556	687
500	**210**	174	213	235	377	327	471	556	687
600	**250**	174	213	235	377	327	471	556	687
750	**300**	174	213	235	377	327	471	556	687
900	**350**	164	213	235	370	327	471	556	687
1050	**400**	139	213	235	312	327	471	556	687
1200	**460**	119	213	235	263	327	471	556	687
1350	**510**	105	213	235	232	327	440	556	687
1500	**570**	93	213	221	204	327	385	556	687
1650	**620**	85	207	201	185	327	349	556	687
1800	**670**	78	190	184	169	327	319	553	687
2000	**750**	69	168	163	149	315	281	486	687
2100	**775**	66	162	157	144	304	270	468	687
2200	**810**	63	154	149	137	289	257	445	687
2400	**880**	58	141	136	125	264	234	405	637
Allowable load on centre roller		1019	2243	1590	2365	2283	3262	3874	4893
Bearing ref:		**420204**	**420205**	**6205**	**6305**	**6206**	**6306**	**6307**	**6308**
Series:		**20**	**25**	**25**	**25**	**30**	**30**	**35**	**40**
The above loads do not include the rotating mass of the roll. The rotating mass of the roll should be subtracted from the above roller load. * shafts are plain and not stepped									

Table 4: Roll Selection - 3 Roll Trough and Impact

2 ROLL VEE & FLAT RETURN									
Belt width:	**Gauge:**	**Allowable load on one roller in kg ***							
600	**310**	174	213	235	377	327	471	556	687
750	**410**	135	213	235	303	327	471	556	687
900	**485**	112	213	235	247	327	468	556	687
1050	**570**	93	213	221	204	327	385	556	687
1200	**645**	81	198	192	177	327	333	556	687
1350	**730**	71	173	168	154	324	289	501	687
1500	**810**	63	154	149	137	289	257	445	687
1650	**895**	57	139	134	123	259	230	397	625
1800	**975**	52	127	122	112	236	209	361	567
2000	**1085**	46	113	109	99	210	186	321	504
2100	**1156**	43	106	102	93	196	174	300	470
2200	**1195**	42	102	98	90	190	168	289	453
2400	**1308**	38	93	89	81	172	152	262	410
Allowable load on centre roller		1019	2243	1590	2365	2283	3262	3874	4893
Bearing ref:		**420204**	**420205**	**6205**	**6305**	**6206**	**6306**	**6307**	**6308**
Series:		**20**	**25**	**25**	**25**	**30**	**30**	**35**	**40**
The above loads do not include the rotating mass of the roll. The rotating mass of the roll should be subtracted from the above roller load. * shafts are plain and not stepped									

Table 5: Roll Selection - 2 Roll Vee and Flat Return

4.3 EXAMPLES – COMPARISON WITH CEMA

4.3.1 Example 1 – Comparison to CEMA C

Consider the use of CEMA C idlers for a 1200 mm wide (48") belt running on 45 degree 3 roll trough idlers and flat return idlers.

Reverting to Table 1 we have:

Idler Class	Belt Width (inches)	Trough Angle			Single Roll Return	Two Roll Vee
		20°	35°	45°		
CEMA C Idlers	18	900	900	900	475	n/a
	24	900	900	900	325	n/a
	30	900	900	900	250	500
	36	900	817	810	200	500
	42	850	791	765	150	500
	48	***800***	***744***	***720***	***125***	***500***
	54	750	698	675	*	500
	60	700	650	630	*	500
	66	n/a	n/a	n/a	*	500
	Ratings based on Min L10 of 30,000 hours at 500 rpm '*' use 'CEMA D' Return Idler					

From the table the applicable minimum load capacities can be read off:

- Loading 3 roll trough = 720 lb (327 kg) roll guage = 460 mm
- Loading flat return = 125 lb (56 kg) roll gauge = 1308 mm
- Minimum bearing life = 30,000 hours at 500 rpm

Analysing the requirements for a three roll trough idler and selecting the roll we have:

- Load on centre roll = 0,7*327*9.81 = 2245 N
- From L10 = (C/P)3 * 1,000,000/60N with L10 – 30,000 hours
- Minimum bearing rating = 10837 N

Referring back to either a bearing catalogue or Table 2:

- **Could select 420204 bearing with dynamic rating C = 12700 N i.e. 20 mm diameter shaft**

If the requirements of SANS 1313 Part 3 were to be adhered to, then from Table 4, for a 460 mm gauge roll the requirement would be 327*.7 = 229 kg.

Reading off the table this equates to a 25 mm diameter shaft with minimum 6205 bearing.

Now consider the Flat return idler – again using CEMA

- Flat return Cmin = 2652 N

In this case there is no bearing in our reference table, therefore referring to the bearing catalogue:

- **Could select a 15 mm diameter shaft with 6002 bearing (C = 5590 N)**

From Table 5:

SANS 1313 Part 3 (1308 mm gauge – which is either a flat return roll for 1200 mm wide belt or V return roll for 2400 mm wide belt) would require the use of a 25 mm dia shaft and minimum 420205 bearing.

Thus in both the trough and flat return case the roll selected utilising the proposed SANS 1313-3 method results in a higher specification.

The most severe case is that of the flat return roller where the CEMA based selection of a 15 mm diameter shaft would result in premature failure due to excessive shaft deflection.

4.3.2 Example 2 – Comparison with CEMA D

Now consider the use of CEMA D.

- Loading 3 roll trough = 1200 lb (546 kg)
- Loading flat return = 375 lb (171 kg)
- Minimum bearing life = 60,000 hours at 500 rpm

Idler Class	Belt Width (inches)	Trough Angle			Single Roll Return	Two Roll Vee
		20°	35°	45°		
CEMA D Idlers	24	1200	1200	1200	600	n/a
	30	1200	1200	1200	600	n/a
	36	1200	1200	1200	600	850
	42	1200	1200	1200	500	850
	48	***1200***	***1200***	***1200***	***425***	***850***
	54	1200	1116	1080	375	850
	60	1150	1070	1035	280	850
	66	n/a	n/a	n/a	215	850
	72	1050	977	945	155	850
	78	n/a	n/a	n/a	125	850
	Ratings based on Min L10 of 50,000 hours at 500 rpm					

For the trough idlers:

P = 546*.7*9.81 = 3746 N
Now the bearing life is changed to 60,000 hours and the minimum bearing rating is 22783 N. And a possible solution would be the use of a 25 mm diameter shaft with 6305 bearing (22,500 N) or a 30 mm dia shaft with 6306 bearing (28100 N)

Utilising SANS 1313 part 3

The roll load is 546*.7 = 383 kg and the requirement is for the use of a 30 mm diameter shaft with 6306 bearing. (table 4)

For the flat return roll

Return idler load = 1895 N
Minimum bearing rating is 11525 N and again the 20 mm dia shaft with 420204 bearing could be selected.

Utilising SANS1313 part 3

P = 171 kg
And from Table 5 a 35 mm diameter shaft with 6307 bearing would be required.

4.3.3 Discussion

It is noted that the above examples are merely a direct comparison of tabulated values not reflecting the full design process, however they give a clear indication of the basic difference in approach proposed by the two codes.

It is clear from the above that the major difference between CEMA and SANS 1313 is the non-adherence in the CEMA code to the shaft deflection criterion. This becomes increasingly significant as the roll length increases.

Utilising CEMA without taking note of shaft deflection can lead to significantly reduced roller life.

When considering SANS 1313 a note to the tables stipulates that 'shafts are plain and not stepped' i.e. the shaft diameter is the same throughout its length.

There is clearly an economical case for reducing the shaft diameter at its ends (depending on loading) and utilising a bearing of smaller diameter. This may however create problems when specifying replacement parts as the user can only readily see the shaft end and will use this as the selection dimension.

5 CONCLUSION

In conclusion, the idler committee of the CMA is constantly reviewing the idler standard SANS 1313 with the aim of maintaining it as the premier worldwide specification.

The soon to be issued revised specification comprising three sections

- Part 1 – defining the dimensional requirements of all rolls and of 'foot mounted' idlers
- Part 2 - defining the specific requirements for under-slung idlers
- Part 3 – defining the performance requirements and load ratings of idlers

will continue to ensure that the South African idler manufacturing sector retains its good standing amongst the worldwide materials handling fraternity.

REFERENCES

SABS 1313 – 1980
SABS 1313 – 1993
CEMA STANDARD 502-2004
Various idler catalogues

AUTHORS' CURRICULUM VITAE

ADRIANO FRITTELLA

Adriano (Adi) Frittella is a graduate Mechanical Engineer from Wits University and is registered as a Professional Engineer.

Subsequent to a short stint as a research officer at the university involved with pneumatic conveying of large particles at high velocity, he joined Melco Mining Supplies (now Melco Conveyor Equipment) where he was introduced to the art of belt conveying.
His career path at Melco covered all aspects involved with belt conveying with specific emphasis on conveyor idler design and manufacture and the design and implementation of conveyor systems.

Adi now operates as an independent consultant in the field of belt conveying. He is an active council member and past president of the SAIMH, is a member of the SAIMechE and (through his company) of the CMA.

Adi has been involved with the Beltcon conference since its inception and is a past chairman of the IMHC committee.

SIMON CURRY

To date the author has been directly involved in the conveyor industry for over 28 years. During this time he has been exposed to all facets of the conveyor industry ranging from mechanical design, manufacture, installation, commissioning, visual and forensic ore clearance audits and feasibility studies. The engineering of conveyor systems for both underground and surface applications are second nature to him. As current chairman of the Conveyor Manufacturers Association he is also active by serving on most of the SABS technical committees responsible for reviewing the national standards relative to all conveyor related issues.

Highlights of his career must be the four patents that he has been able to register as well as various firsts of conveyor installations conveyor systems like the first powered tripper drive in South Africa. Another milestone worth mentioning is the class 1250 solid woven dual booster conveyor designed for an underground application at an overall length of 7300 m.

Current employment is with Sandvik Materials Handling as manager of engineering for underground materials handling systems.