NATIONAL CONVEYOR BELT SPLICING STANDARDS
SANS 484 PARTS 1 AND 2, SANS 485, SANS 486

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1. SYNOPSIS

The purpose of the paper is to create awareness for the reader of the existence of new Splicing Standards/Specifications in South Africa. Splicing has for many years presented problems to users and manufacturers alike, and there is a serious need to start regulating an industry where vendors are literally doing as they see fit, without any input from a knowledgeable source. This paper explores the status quo, the advantages and disadvantages of having such specifications, and, for the purpose of marketing the specification to the conveyor industry briefly explains the contents of the specifications.

2. INTRODUCTION

At the time of writing this paper, there are no national conveyor belt splicing standards for any of the three commonly used types of conveyor belting (Steel cord reinforced, Plied textile reinforced and Solid woven Poly Vinyl Coated or Poly Vinyl/Nitrile Coated) in existence anywhere in Africa. The industry as it now stands contains very few people with formal training in Polymer Technology, leaving the manufacturers and users equally at risk. South Africa is partially locked into a situation whereby splicing/polymer knowledge has been passed down from generation to generation without input from trained polymer technologists. Currently, in this country we rely heavily on input from overseas to develop polymers to ensure reliable belting and durable splices. At best, knowledge passed on in this way might easily result in misconceptions without users realising the associated risk. Realistically, what is considered in this country to be current up to date knowledge/technology is in many instances out of date. As examples of unacceptable splicing practices being passed on through the years, consider the importance which is still being placed on buffing textile carcasses whilst preparing a plied textile reinforced splice, or the erroneous belief that copious amounts of rubber solution are required whilst assembling a steel cord reinforced splice. Both of these practices did and still do, result in many splice failures throughout the industry. Training/knowledge in the handling and use of dangerous chemicals that all splicing constructors handle on a daily basis, is also sadly lacking. Whilst splicing constructors are obviously not required to be qualified chemists or polymer scientists, there is a safety and health risk associated with use of such materials which is often not recognised or catered for.

Present day losses as a result of splice failures associated with poor workmanship and/or practices are enormous. The major issues associated with splice failure relate to safety and costs resulting from lost production and also replacement splices. For this reason the industry has for some time required a workable splicing code of practice in a user friendly, easily understandable format.

In 2007 the Conveyor Manufacturers Association (CMA) working group committee for conveyor belting standards, unanimously decided to research, compile, and introduce world class splicing standards specifically applicable to South Africa. South African National Standards were approached and the various SANS specifications for splicing started taking shape.

The working group comprises members drawn from belting manufacturers, conveyor belt owners/users and some independent specialists, and the efforts of the working group are supported by the CMA. All members of the workgroup are volunteers but have a thorough knowledge of conveyor belting and its various applications.

3. SAFETY

To date there have been minimal personal injuries or fatalities directly associated with splice failure in South Africa. It is however, unlikely that this situation will prevail for much longer, considering the increase in production requirements, while the number of personnel is being reduced. To illustrate the possible consequences of a catastrophic splice failure, consider a 2000 metre centre distance, 14 degree incline, shaft conveyor system. Typically a high-tension shaft conveyor would require a steel cord reinforced belt, and although a steel cord splice is relatively simple to construct, great care is still required, as serious errors can and do, easily pass unnoticed. Obviously a splice failure would occur in an area of high tension – typically approaching the head or the drive, depending on the conveyor geometry. Following splice failure, in the region of 100 tonnes (depending on the belt class) of out of control belt, not to mention the material on the loaded belt, would hurtle back down the shaft. As this is all taking place in an enclosed area, any personnel present in the shaft at this time, would have minimal chance of escape and serious injuries and fatalities would be likely. All of this would strengthen the case for the use of some type of belt arresting device, but it does not detract from the fact that a very dangerous situation is created by not producing high quality splices. Safety is not negotiable for any user and any unsafe event is to be avoided at all costs. Furthermore, to get the shaft back into production could take several days, creating a new set of safety problems while trying to reinstate the conveyor, and immense logistical problems trying to remove the broken belt from the bottom of the shaft.

4. COST AND LOST PRODUCTION

In order to demonstrate the losses incurred by failed splices, it has been calculated that even a single splice failure occurring in each platinum mine in South Africa, would result in total production losses valued at more than R500,000,000 per annum. It is likely that there are far more failures than the number quoted and it is estimated that losses due to poor splicing is costing industry as much as R2,5 billion per annum. If other mining industries such as coal, gold, diamonds and base mineral mining operations are taken into account, the losses in production are staggering. The current situation as far as splicing is concerned is that the industry is unregulated and uncontrolled in almost every respect.

Other than independent user specifications controlled by auditing (this is successful, but only if rigidly monitored), there are no national skills, materials or equipment standards in issue. It seems severely unbalanced if one considers the emphasis placed on belt quality during manufacturing, and the cost of belting, while on the other hand there is no formal protocol or regulation for splicing. The cost of belting for an overland conveyor recently installed at a coal mine amounted to more than R 65 million. The success of this system hinges on the construction of splices by personnel with no formal training, and only the belting manufacturer to guide him in terms of what materials to use to perform the splice.

The procedure for selection of splice contractors under current conditions are based almost entirely on monetary criteria. This unfortunately leads directly to cost cutting exercises being of primary importance to the contractors themselves.

It is often the case, especially with the less experienced vendors, that unsuitable and un-calibrated equipment is used. Furthermore, a significant reason for splice failures is the use of incompatible raw materials.

Incompatibility takes two forms, one being that the raw material is unsuitable for use with any manufacturer's production conveyor belting, and two, that the raw material has not been adequately tested and verified as suitable for use with a specific manufacturer's production conveyor belt. The use of incompatible raw material can result in catastrophic splice failure. The above could be as a result of either ignorance and/or an attempt to cut costs.

In light of the above, the CMA working group has produced four national splicing specifications/standards for implementation and use by the industry.

These specifications/standards are designated as follows:-

- SANS 484 part 1: Hot vulcanised splicing of textile reinforced belting.
- SANS 484 part 2: Cold splicing of textile reinforced conveyor belting.
- SANS 485: Splicing of steel cord reinforced conveyor belting.
- SANS 486: Splicing of solid woven conveyor belting.

These standards are for the benefit of industry as a whole.

However, although having a standard is a positive step, enforcing it is more important. For that reason it was agreed between industry and SANS that as soon as the above mentioned specifications have been released and published, all splicing vendors will be required to have accreditation. It is fully understood by CMA and the working group that such a requirement is likely to provide industry with a dilemma, if suddenly the splicer that a particular mine has been using for a long time, requires accreditation in order to work at such a mine. The mine would have to make a decision to either employ the splicer and take the risk associated with it, or employ an accredited vendor and have peace of mind that consistent good splices are being performed. It is the opinion of the authors that having accredited splicers, working to a set standard, will separate the good from the bad vendors, and result in a large saving to the mining industry as a whole.

The CMA working group recommended that a splicing school, under the auspices of the CMA, be established as a matter of urgency. The purpose of the splicing school is to provide accredited training to individuals enabling them to perform splices without the necessity of outside supervision or continuous on-site monitoring. Such an individual would carry a ticket, similar to that of a plumber or an electrician. The splicing school would have the necessary accreditation as a training body.

In addition to a splicing school, an SABS permit scheme would be applied. Companies will be audited by the SABS to ensure that the quality standards, workmanship and materials used conform in every respect to the applicable South African National Standard. The SABS will also conduct audits of the training provided to the splicing constructors/personnel. If granted an SABS permit the company concerned will be entitled to apply an SABS mark to each splice carried out by their personnel on site. A system would be put in place whereby a vendor could lose his SABS accreditation should there be quality complaints lodged with SABS or CMA.

It is also understood by industry and CMA that all of the above is likely to increase the cost of splicing, but the authors are yet to find anybody that is not willing to pay more for a reliable, fully auditable and guaranteed splice.

All process control documentation pertaining to the splice would be in accordance with SABS approved Quality Control Systems/Programs. The role of the conveyor belt owners/users would be to insist on only SABS accredited splicing companies, undertaking any splicing on their belting. The specifications/standards now compiled, cover acceptable and non-acceptable practices, material approval criteria and a quality system guideline.

It has to be noted that splicing specifications do not stipulate or dictate to the vendor the manner in which splicing is performed, as this would be a matter of personal choice. It is not the intention of the specification to teach the vendor how to do the work, but rather to provide a guideline regarding acceptable practices and minimum standards. The specification does however address the following:-

4.1 TERMS USED

Commonly used terms are addressed in the specifications. This is to ensure that all users and vendors speak the same language and that there is no ambiguity regarding certain terms.

Tools were addressed and the correct tools for certain tasks were identified and named accordingly.

4.2 LENGTHS OF SPLICES FOR VARIOUS BELT CONSTRUCTIONS AND CLASSES

Table 1 shows the minimum recommended step lengths for plied belting for hot and cold splices.

Belt Class	Number of Plies per Belt				
	2	3	4	5	6
160	300				
200	300	250			
250	300	250	250		
315	300	250	250		
400	300	250	250	250	
500	250	250	250	250	250
630	300	300	250	250	250
800	400	400	300	250	250
1000	500	400	400	300	250
1250		450	400	300	300
1400		450	450	400	300
1600			450	400	400
2000			450	450	400
2500				450	450

Table 1: Minimum recommended step lengths

Table 2 shows the minimum step length of cords for steelcord reinforced belting.

Class	Number of Stages	Minimum Step Length	Butt Gaps	Transition Zone
		mm, min.	mm, min.	mm, min.
St500	1	550	-	50
St630	1	550	-	50
St800	1	550	-	50
St1000	1	700	-	75
St1250	1	700	-	75
St1400	1	850	-	100
St1600	1	850	-	100
St2000	2	550	25	125
St2500	2	700	25	125
St3150	2	900	25	150
St4000	*	*	*	*
St5000	*	*	*	*
St6300	*	*	*	*

Table 2: Minimum step lengths of cords

Table 3 shows the recommended dimension of the fingers for a solid woven belt finger splice.

Finger splice length and base		
Tension Rating	Finger Length	Finger Base
kN/M	min (mm)	min (mm)
630	600	50
800	750	50
1000	900	50
1250	1100	50

1400	1300	50
1600	1500	50
1800	1700	50

Table 3: Recommended dimensions

4.3 SPLICING MATERIALS AND RELEASE AGENTS.

This section gives guidance in terms of compatibility of compounds, the shelf life of components, bonding agents and acceptable release agents. Materials and agents not mentioned in the specification would require a concession from the client who has requested a splice in accordance with the relevant SANS specification. This section also provides guidelines in terms of the recording of possible defects during and after the splice has been constructed and completed.

4.4 EQUIPMENT USED – THE PRESS

In this section of the specification the vulcanising press is addressed, the platen sizes, thermocouples and the edge bars. It refers to calibration certificates, it considers the temperature of the press as well as the operating pressure and provides guidance for temperature ramp times.

4.5 SPLICING CONDITIONS AND WHEN CONDITIONS ARE NOT ACCEPTABLE

Until now the splicing contractor could splice under any weather conditions, or the mine could pressurise the splicer to perform the splice due to the criticality of the conveyor. Whether or not the splice was then successful was a matter of great risk to the mine. The newly produced specifications are very clear with regards to weather conditions and humidity. The specification also refers to conditions under which splicing is not permitted. This will protect both users and splicing contractors against risk of splice failure due to splicing in non-favourable weather conditions.

4.6 SPLICE CONSTRUCTION METHOD

The specification is not prescriptive in terms of the methods that must be used to construct the splice. It does, however, set minimum standards that must be adhered to when building the splice.

4.7 HEALTH AND SAFETY ISSUES

The South African mining industry has a poor safety record and it was deemed fit to add a section on health and safety issues. Material safety data sheets for the various chemicals used are addressed. Furthermore, the disposal of used material is addressed as this poses a significant risk to personnel and the mine environment if not properly managed.

4.8 BEST PRACTICES.

This section of the specification refers to the splice construction, the cleaning and trimming of the splice and storage and recording/traceability of raw materials.

4.9 PRACTICES NOT PERMITTED

Often, while not knowing any better, the splicer will perform an action not permitted, such as using expired splicing materials. This section of the specification deals with these practises and attempts to eliminate them in order to provide a more reliable end product to the user.

4.10 REJECTION CRITERIA OF A SPLICE

The user will now be entitled to legally reject a splice if the splicing contractor does not follow the specification; if there are bulges on the belt; if the belt runs out by a particular margin indicating that the splice is not longitudinally within parameter; or due to any non-conformance by the splicing contractor.

4.11 TESTING OF THE COMPLETED SPLICE

The specification allows the user to test the splice, in the presence of the splicing contractor, for an entire cycle of the belt, under load. Compliance documentation shall be available prior to splice construction and provided with the Quality Control documentation upon splice completion.

4.12 MARKING AND BRANDING

Guidance is given in terms of marking and branding the splice in such a manner that it is completely traceable for future reference.

4.13 SPLICE REPORT

A method of reporting is recommended, again for the end user to have peace of mind that the correct methods and splicing materials were used. Each splice will have its own data pack, providing all the necessary documentation and certificates.

5. CONCLUSION

The standards that have been drawn up are by no means the final step towards reliable splicing, but it is a start towards regulating an industry previously mostly uncontrolled. It must be stressed that the success of the newly developed splicing standards depends entirely on users/owners insisting that only SABS accredited splicing companies carry out splicing within their organisations, using accredited personnel. Costs are naturally likely to be higher on a per splice basis. However, when this is considered over the long term, total cost of ownership basis, the cost will be greatly reduced as a direct consequence of fewer, more reliable splices which equates to less downtime and therefore reduced production costs. In addition and of significant importance, is the reduction in risk of catastrophic failure which could result in injuries or worse which may occur as a result of failed splices.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

SANS 484 Parts 1 and 2
SANS 485
SANS 486

AUTHORS CV'S

ANTHONY J. MILES (Presenter)

Anthony (Tony) has been actively involved in the materials handling industry (mining), throughout Africa since 1966, through his employment with international conveyor manufacturers. Tony has been independent since 1992.

He is a member of the SANS/CMA working group relating to conveyor belt specifications and standards, and has acted as an advisor to the South African Bureau of Standards with reference to test procedures specifically concerning steel cord reinforced conveyor belting. Tony has researched and presented a paper (subsequently published), on conveyor belt steel cord test equipment and methods, which have been incorporated into the current South African National Standard – SANS1366 – Steel cord reinforced conveyor belting.
He is currently conducting specific research and development together with the South African Council for Scientific and Industrial Research on conveyor belt compounds, under contract to a major mining corporation.

Tony is a consultant in the field of conveyor belting and splicing, the testing thereof, and systems, to:-

- Anglo American Corporation (Coal, Gold, Platinum and Base Metals).
- DeBeers Group Services.
- Debswana Diamond Company (Proprietary) Limited. (Formerly DeBeers).
- Dunlop Belting Products.
- Eskom.
- Fenner Conveyor Belting.
- Impala Platinum.
- Sasol Mining.
- Sasol Synfuels.
- PPC.
- Veyance Technologies (GoodYear Engineered Products).

Tony also consults to major contractors (O.E.), for both local and overseas materials handling conveyor projects.

PAUL NEL

Paul is originally from a structural background but has spent the majority of his working life being involved in materials handling projects. He is a professional member of the South African Institute of Materials Handling and is a member of the SANS / CMA working group responsible for writing specifications related to conveyor belting.

He spent the last 15 years with the Anglo American Corporation within Anglo Technical Division, Specialised Engineering, and is responsible for matters relating to materials handling related.

DAVE PITCHER

Dave Pitcher has worked in the materials handing industry since 1974, focusing predominantly throughout his career on belt conveyor systems and conveyor belting in particular. H started as a sales representative for Gandy Belting division of SA Canvas in

Durban where it was necessary to select the belt and then deliver and install it on the conveyor system. From 1975 through to 1992 he was employed by BTR Sarmcol and involved in development of new products for manufacture in South Africa. He was further involved in the introduction of synthetic textile reinforced multiply conveyor belting through to steel cord reinforced conveyor belting. Dave spent a few years in the design of belt conveyor systems for original equipment company Group Five Goodwin and then joined Dunlop Belting Products as Technical Services Manager in 1998. In August 2008 he accepted the position of Technology Manager at Fenner Conveyor Belting, part of the worldwide Fenner Dunlop organisation. Dave has a Diploma in Datametrics from UNISA and a Diploma in Design, Operation and Maintenance of Belt Conveyors from CMA, both obtained with distinction. A director of the Conveyor Manufactures Association and a fellow of the SA Institute of Materials Handling, and has been a Committee member of SABS standards organisation for drawing up of conveyor belting standards since 1979. He has also written and presented papers at the International Materials Handling Conference, Beltcon, on design of chutes, predicting the life of conveyor belting and joining conveyor belts. He serves on the organising committee of IMHC.