Conveyor Safety

Task analysis procedure helps identify, reduce risks

By George A. Schultz

THOUSANDS OF MILES AND HUNDREDS of types of conveyors are used throughout the U.S. on a daily basis. Mining, agriculture, manufacturing, construction, warehousing and transportation rely on conveyors/conveyor systems to efficiently move goods. However, nearly 10,000 operating- and maintenance-related accidents occur each year (Toney), while 30 to 40 deaths are attributed to conveyors/conveyor systems annually (BLS). Materials handling accidents of all types account for more than 25 percent of all workplace accidents (FFVA).

Most SH&E professionals are familiar with the following hierarchy of controls:

1) **Hazard elimination.** If practical, design the hazard out of the product, workplace, job or facility through engineering means.

2) **Safety guards and enclosures.** If the hazard cannot be eliminated, enclose or guard it at its source to protect users.

3) **Safety warnings and instructions.** If the hazard cannot be guarded, warn or instruct users regarding the dangers of the product under foreseeable conditions of service.

4) **Protective equipment and administrative controls.** As an interim or temporary safety measure only, until higher-order safeguards can be installed, provide the user with PPE or apply administrative controls.

Safety thinking is still in basic agreement with the order and preference of these controls. However, it should be understood that before relying on any instructions, warnings and training, all technological and economically feasible changes, including guarding, must first be used (Gallagher).

Since 1947, ANSI has issued ANSI/ASME B20, Safety Standards for Conveyors and Related Equipment. It is recommended that these standards be used by engineers/designers, manufacturers, installers and owners/operators of conveyors/conveyor systems. Some conveyor system safety features can be incorporated into the design and manufacture of conveyor equipment. However, other safety features depend on the form of the building and support structures and methods of

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Conveyor Terms

Belt Conveyor: This device is a continuous fabric, rubber, plastic, leather or metal belt operating over suitable drive, tail end and bend terminals, and over belt idlers or slider bed for handling bulk materials, packages or objects placed directly on the belt.

Flight Conveyor: This machine is comprised of one or more endless propelling media, such as chain, to which flights are attached, and a trough through which material is pushed by the flights.

Nip Point: A point at which a machine element moving in line meets a rotating element in such a manner that it is possible to nip, pinch, squeeze or entrap a person or objects coming into contact with one of the two members. The same definition holds for the similar point with respect to two rotating parts or two converging parts in linear movement.

Shear Point or Line: The point at which or the line along which a moving part meets or passes close enough to a stationary or moving part or object so that part of the human body can be caught, trapped or pinched between them.

Source: ASME B20.1.

installation. In addition, some safety features depend on the owner's operation and maintenance procedures. Thus, conveyor safety measures often depend on more than one of the parties involved in a conveyor system contract (ASME).

It is important to note that OSHA 29 CFR 1910 contains no specific regulations related to conveyor safety and training, although the general industry standards do contain regulations covering other materials handling equipment, namely fork trucks (1910.178) and cranes (1910.179). Therefore, when investigating conveyor-related accidents, OSHA generally cites the General Duty Clause (5)(a)(9).

Case Example: Bakery

A large commercial bakery contained several semiautomatic polybag packaging lines (Figure 1). The polybaggers were adjustable and could be set to handle most packaged loaves of bread normally seen on supermarket shelves. The machines were integrated with and fed by a flighted in-feed chain conveyor that had to be manually loaded with unwrapped bread.

These operations generally required a foreperson (a full-time employee) and several part-time workers who manually placed the unwrapped bread products into the polybag in-feed chain flight conveyor. On a given line, these bagging operations ran three to four hours per shift. Part-time workers (averaging 20 hours per week) were employed to perform this task.

In the middle of a shift, a polybagger line had to be changed over to bag another type of bread product and size. According to standard procedure, the line was shut down and a mechanic was called to readjust the equipment. While the system was down for adjustment, the foreperson instructed a part-time worker to clean up the flighted in-feed chain conveyor. This involved using rags and brushes to remove bread crumbs on the top and underside of the conveyor, then vacuuming the floor. While adjusting the polybagger, the mechanic had to "actuate" the unit for alignment, causing the in-feed conveyor to move. The part-time worker who was cleaning at the underside tail end of the conveyor got her hand caught in the tail pulley and her fingers were severed.

Case Example: Solid Waste Recovery Facility

An inclined side wall cleated belt conveyor was provided as part of a waste recovery system (Figure 2). The conveyor belt could not be trained and the jammed unit was down much of the time.

Since the original designer/manufacturer of the system did not respond promptly to the owner/operator's request for assistance, a maintenance worker devised a guide roller that made the unit operable, but required frequent realignment. During realignment, the tail take-up pulley guard had to be removed and the conveyor belt then aligned by adjusting the screw take-up while the conveyor was running.

Figure 1

Bakery Polybagger & Conveyor

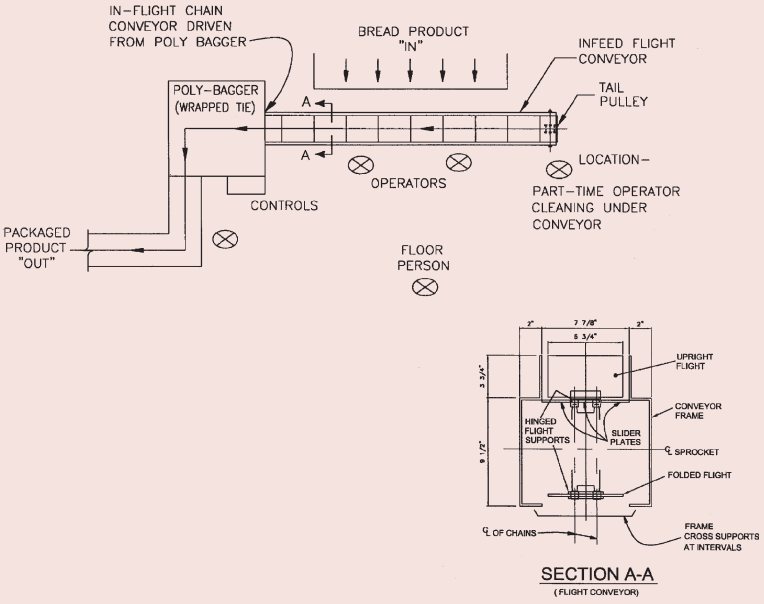
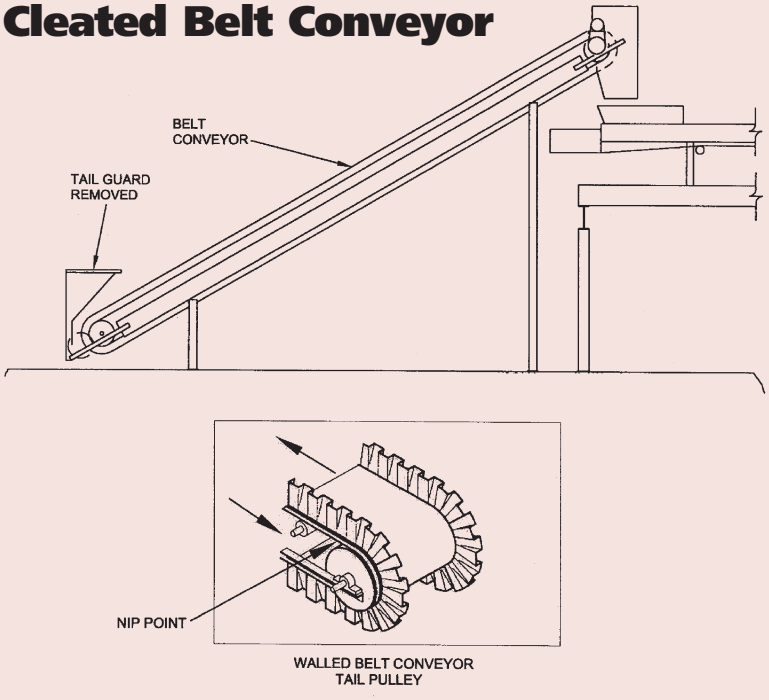


Figure 2

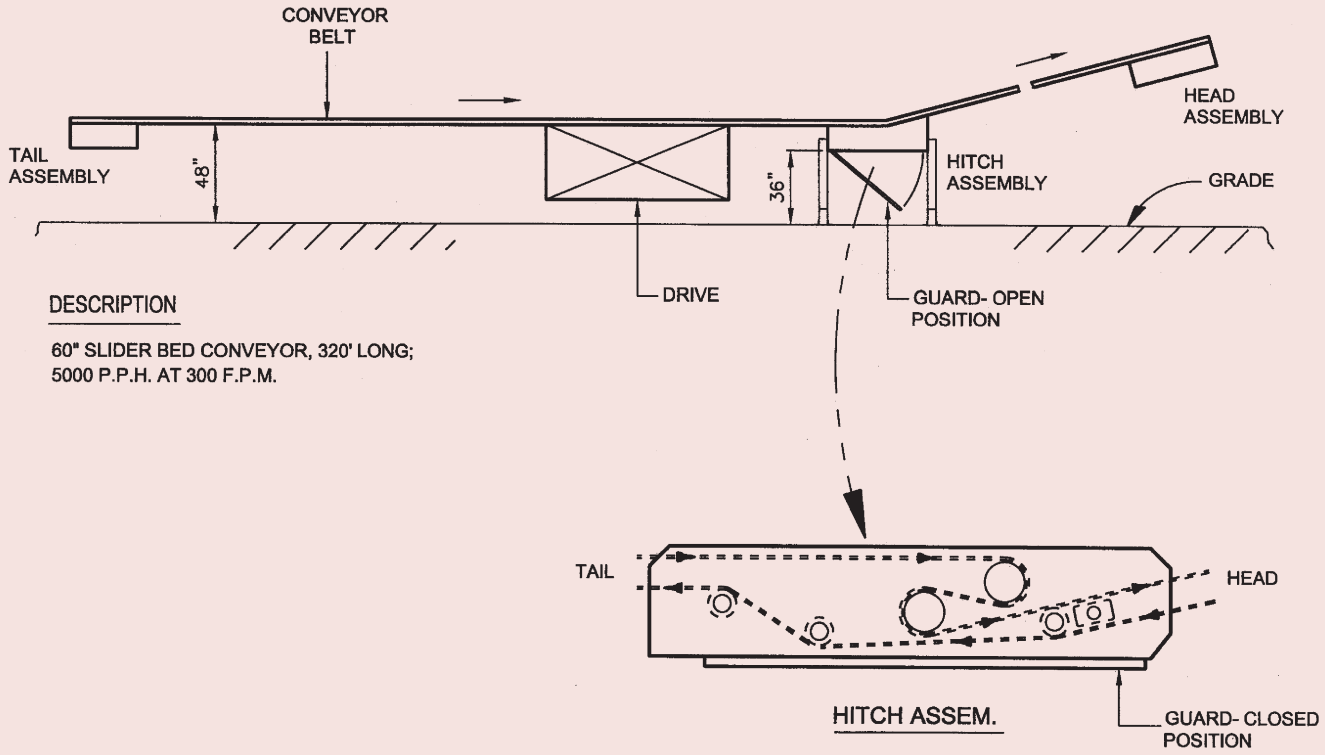
Waste Recovery Site: Cleated Belt Conveyor



While realigning the unit, the maintenance worker discovered that he needed a part and went to retrieve it, leaving the tail take-up guard off. A foreperson (who was not involved in the realignment process) observed debris collecting at the tail pulley,

Figure 3

Distribution Center: Conveyor Drives & Hitches



which could cause the conveyor belt to untrack. He reached in to remove this debris and his hand was caught in a pinch point. He lost his arm as a result.

Case Example: Package Delivery Service Distribution Center

A worldwide package delivery service company's distribution center contracted its maintenance work to an outside labor service firm. This firm provided experienced and trained personnel to maintain the miles of conveyors housed in the facility.

Conveyor drives and hitches were located under the conveyors, but all were readily accessible and properly guarded (Figure 3). A joint lockout/tagout (LOTO) program was established between the owner and the labor service firm per OSHA standards (OSHA). Full conveyor maintenance included cleaning, and required that conveyor guards be opened and that the unit being serviced be LOTO. Preventive conveyor maintenance (PCM) involved opening guards to visually inspect drives and other conveyor parts and to lubricate only exposed bearings.

An experienced, well-trained worker assigned to provide PCM service opened the guard to inspect under the conveyor hitch. For reasons unknown, he crawled under the unit, where he used a small paint brush to remove dirt from the drive support while the conveyor was operating. Both of his arms were dragged into the unit and his upper body was severely injured. All equipment and switches for LOTO were located just five feet from where he was injured.

The Task Analysis Procedure: Why, Who & When

Risk-taking actions, such as those described in the three case examples, can and do occur in all industries and on all types of conveyors and conveyor systems. Conveyor-related injuries involving workers' fingers, hands, arms, or legs being caught up in conveyor nip or shear points generally occur during these activities.

Based on 20 years' experience investigating conveyor-related accident cases, the author has found that 50 percent of these accidents involve one or more of these activities:

- cleaning and/or maintaining a conveyor (20 percent);
- reaching into a conveyor to remove debris or free a jammed conveyor (five percent);
- a tool, cleaning device or employee's clothing being caught in a conveyor (five percent);
- employee falls reaching into an improperly or unguarded conveyor pinch point (20 percent).

To minimize these hazards, the owner/operator must assign a knowledgeable staff member or hire a consultant to conduct a task analysis procedure (TAP) to identify risk factors, and provide design measures and procedures that will eliminate or mitigate the identified risks (Bell). The TAP should be prepared for all new installations, when equipment is relocated or rearranged, and/or if new equipment is installed or new operating procedures are implemented. Table 1 presents a completed TAP form based on the bakery case example.

Had a TAP been conducted, the bakery accident may have been prevented. In the waste recovery case, a TAP would have revealed the need for maintenance personnel to provide a temporary barricade at the exposed pulley, and also that the owner/operator needed to provide the foreperson with workplace conveyor safety training (ASME). Finally, in the package delivery facility, even when a conveyor is proper-

Table 1

Task Analysis Procedure: Bakery Case Example

1) Define the conveyor/conveyor system.

a) Purpose b) Operation c) Arrangement

A semiautomatic polybag packaging operation was used in a bakery. System consisted of an oven bread delivery conveyor that delivered bread which dropped down a chute adjacent to the in-feed conveyor. Unwrapped bread products were then picked up and manually placed in the flights of the in-feed conveyor by the part-time workers for delivery to the polybagger.

2) Identify all personnel who will come in contact with the conveyor/conveyor system. Determine job responsibilities and interview workers.

Operators	Maintenance	Others
•Supervisors	•Preventive	•Materials handlers
•Full-time	•Cleanup	•Clerical
•Part-time	•Scheduled	•Pedestrians
	•Changeover	
	•Emergency	

The four employees and their duties involved:

One foreperson was responsible for line supervision. Two full-time workers and three part-time workers manually placed bakery products into the in-feed conveyor, cleaned up and complied with the supervisor's directives. The maintenance worker provided preventive, changeover and emergency line maintenance of the bagger for new product, per schedule or as required.

3) Establish job duties and break down into tasks/steps.

•Define duty: General job responsibilities that can involve one or more tasks.
•Define each task: Establish units of activities.
•Quantify steps: Specific action required to perform task (e.g., stand, turn, reach).

The foreperson's tasks should have included supervision of the overall line production and quality, as well as an understanding of the assigned personnel's work requirements and total schedule. The line mechanic's TAP should have included the need to "jog" the polybagger and in-feed conveyor as part of any product changeover. The part-time workers received no formal training covering cleanup nor any workplace conveyor safety training. A detailed TAP of their duties could have revealed the need for such training.

4) Identify and quantify risk factors.

a) Personnel working alongside the in-feed conveyor required sanitary and protective clothing to provide sanitary handling and minimize chances for clothing to be caught up in the conveyor.
b) During preventive maintenance and clean up, the system should have been locked out and tagged out per OSHA and ANSI standards.
c) During changeovers, the system needed to be started and stopped to adjust the polybagger.
d) Operation and maintenance should have been performed only by individuals who had been through a TAP and property trained.

5) Eliminate/mitigate risk factors by implementing:

•Technology improvements
•Administrative controls

a) Workers should have been required to wear sanitary, tight-fitting clothing.
b) The system should have been provided with LOTO equipment and the foreperson and line mechanic should have been trained in its application (OSHA).
c) The system should have been equipped with an alarm that operated 30 seconds before the system started up (ANSI).
d) A pull-cord emergency switch should have been provided along the in-feed conveyor (ASME).
e) The owner/operator should have provided conveyor safety training.

ly guarded and serviced by experienced, well-equipped personnel, accidents can occur if management does not enforce its safety requirements.

Therefore, to operate and maintain conveyors/conveyor systems safely, the owner/operator needs to conduct a detailed task analysis for all employees covering all of their job responsibilities. Then, the owner must take action to eliminate all safety risk factors identified. Finally, the owner must establish administrative controls to ensure that the safety requirements established are enforced. ■

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