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ASSESSMENT AND PLACEMENT OF PHYSICALLY RESTRICTED AND HANDICAPPED EMPLOYEES

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Industry as a whole shares a common concern in regard to injuries, restrictions, handicaps, and incidences of handicapping conditions. They have many programs to insure that employees are placed in a safe work environment.

Reliable statistics of the number of injuries resulting in a handicapping condition are difficult, if not impossible, to obtain. Many figures are available, but they vary greatly from source to source. The following was discussed by Raymond S. Nickerson in a recent issue of the *Journal* of the Human Factors Society. The Bureau of Education for the Handicapped of the U.S. Office of Education published statistics that would suggest an incidence of handicaps in the general population of something greater than 10 per cent. The U.S. Department of Health, Education, and Welfare estimates 41 million handicapped people in the United States and points out that HEW's definition of handicap does not include temporary disabilities, which at some point could outnumber those that are chronic and permanent handicaps. For the most part, I will be talking about these temporary disabilities. I will also discuss a program designed for hiring and placement of the handicapped.

There is an increasing awareness of the needs of the handicapped by both business and government. As we all know, legislation at both state and federal levels has been enacted for the purpose of meeting the needs of the handicapped. We recognize not only the need to hire the handicapped, but also the need to place the many employees who become handicapped during their working years.

In the past, the attitude of many manufacturers, particularly at the foreman level was that "any foreman worth his salt would get rid of a cripple." Fortunately, today that attitude is obsolete morally, financially, and legally. You may be reluctant to believe that, in most cases, the sooner an employee is back to work the better the outlook for the employee's full recovery. However, a quick look at the cost of today's benefit programs may change your mind. If that doesn't make a believer of you, a review of the aforementioned handicapped legislation will certainly get your attention. I'd like to describe Pontiac Motor Division's program, which not only results in prompt return of employees with job-related injuries, but also deals with all types of medically restricted people. It is a practical program in that it doesn't require the use of any new and big ideas, but rather is a realistic application of existing procedures in which the efforts of all departments involved are coordinated by an individual referred to as the placement coordinator (PC).

Let's start with some numbers. Pontiac Motor Division is a large industrial complex of basically 12 individual plants at one location. It employs approximately 14,500 hourly employees, plus 3,500 salaried. In the past four years, October 1974 to June 1, 1978, 2,357 seniority employees with restrictions, and 75 new hires, also with restrictions, were placed on full time jobs. From this total of 2,432 employees, only 102 required interplant transfers in order to find job assignments. These numbers should also leave the impression that at least the potential for a lot of dollars is involved

66th NATIONAL SAFETY CONGRESS

Papers Delivered in the AUTOMOTIVE, TOOLING, ETC. SESSIONS

Placement of Physically Handicapped Employees	Ronald L. Bower	3
Exploring New Horizons on Placement of the Handicapped	David W. Finnerty	7
The Role of the Rehabilitation Counselor	Erskine Miller	11

Papers Delivered in the POWER PRESS & FORGING SESSIONS

Stop Time Measurement—Separation Distance	Dennis R. Ebens	15
Control Reliability for Part Revolution Clutch Presses	Mathew F. Einecker	19
Power Press Construction Requirements	Frank H. Holland	23
Officers of the Automotive, Tooling, etc. Section 1978-79		28
Officers of the Power Press and Forging Section 1978-79		30
Order Blank for Other Volumes, 1978 Congress Transactions	Back Cover	

even if only a day or two could be reduced from each individual's non-working period. With the benefit packages now in effect, a non-working employee can show an added cost to a company of approximately \$65 per day.

The number of new state and federal laws and programs regarding veterans, handicaps, race and sex discrimination, and even our labor contracts, which continually liberalize benefit programs, make all of us wonder if we will really be able to run the business both now and in the future. Thus, any system in industry that puts people on full time productive jobs bears close scrutiny.

The placement coordinator program is such a system. Simply stated, the PC program is a system where the individual is examined, medically classified, and has medical restrictions defined by the medical department. The restrictions and the available work are matched by the PC, then the employee is placed on an available full time job or appropriate non-working status.

To describe Pontiac's program, we must dispel the natural tendency to think only in terms of injured employees when in reality all types of actual and potential employees are involved. Working employees can be on either unrestricted or restricted work or on special placement. Non-working employees can be in one of several categories, from short term disability leave to long term extended disability or total and permanent disability. Labor relations cases take more forms but usually involve return from penalty, discharge, or unauthorized leave.

The hiring of handicapped applicants can easily be one of the areas where a PC will be beneficial, primarily due to affirmative action programs for the handicapped. For a moment, I would like to talk about the medical departments and some very definite do's and don'ts in regard to the handicapped affirmative action programs. Medical Department personnel do not refuse employment opportunities to anyone. They do not use the phrase, "You didn't pass your physical." Medical personnel do evaluate and classify the applicants and advise

the PC and employment office of the results. Fortunately, the classification system used in evaluating persons under the handicapped program works splendidly for all types of actual or potential employees, i.e., both working and non-working as well as new hires. The classifications used are: (1) able to work without restrictions; (2) able to work with restrictions (specify—it is sometimes better to sub-classify this as 2A—minor, and 2B—major restrictions, to ease the load of the PC); (3) deferred, due to an unstable condition that prevents any employment. You may evaluate these later when the condition becomes stable. Remember, the key words here are stable and unstable when choosing between class 2 or 3. For example, a man with a broken leg healing in a cast is unstable and in class 3, but a man with an amputated leg with a healed stump and an artificial leg is stable and in class 2.

The placement of employees at Pontiac motor evolved from the "vicious circle" method where shrewd employees (or a sharp foreman who wanted to get rid of a "cripple") could cause a career to be spent revolving in a circle between work assignments, medical department, employment, labor relations, etc. The result was usually the employee going on a series of disability leaves or, more often than not, ending up in "sanitation." We say sanitation in quotes because these people were given a broom, a dustpan, a stool, and very little in the way of a specific work assignment, even though it was hoped they would do something besides collect their paycheck. "Out of sight, out of mind" was the byword, and I'm sure many of you may recognize this as a placement system going on in your own plant. All departments, with their particular type of employee problems, can now work through the medical department and the PC to find the proper spot for the employee.

Probably the most frequent criticism we receive from people who are not familiar with the placement area is: "It's easy to place restricted people at Pontiac Motor Division because there is such a large variety of local plants and jobs. Besides, the union contract allows inter-plant transfers,

seniority permitting. But, at our home plant, which is basically one type of operation, it's very difficult to find jobs with varying requirements."

In rebuttal, we say less than five per cent of our cases required an inter-plant transfer. All employees are entitled to certain rights and benefit programs, and if the rules are accurately followed, the proper place will be found, even if it is on disability leave because no specific work is available in line with seniority, etc. Amazingly, though, good, prompt administrative work by PC will reduce the overall number of such cases to the absolute minimum. At that point, it becomes a generalized question of re-evaluation by upper management of obligations and responsibilities to its employees and applicants. Vocational rehabilitation and sheltered workshops are other concepts to consider. In any case, an effective PC can develop a program where "everybody will be in the right place."

Now, a few comments regarding items that we have found important and which we highly recommend you consider if or when you set up your own PC system. I have found that whenever an administrative problem develops in our program it is usually because someone has run afoul of one of the following items.

The medical department is the backbone of a placement program. The plant physician, when defining restrictions, uses all available medical data—his own tests and examinations and the family doctor's data—to determine the employee's status. But only medical department restrictions are officially accepted by the plant. Use meaningful lay-medical terms in the reports to the PC, i.e., "sprained ankle" vs. "personal condition" or "fainting spells" vs. "medical condition." It is very difficult for a PC to accurately assign jobs if all he knows is "personal condition" rather than "sprained ankle."

Do not use job assignment terms; this belongs to the PC. For example, if an employee cannot do production line work, say "off line work" instead of "cafeteria janitor." Off line work gives the PC much more flexibility in assignments. State specific time limits,

and encourage shorter time periods with renewal if necessary. As people obtain more seniority, the need for medical restrictions may not exist, since the employee may have "found a home" contractually. Avoid "indefinite" and use "permanent" sparingly. This prevents future problems. Do not change a restriction unless medical facts warrant a change or review shows a mistake has been made. Sometimes the employee is assigned another area and misses his card game or ride, but this is no basis to cancel medical restrictions.

Be consistent in your opinions. Restrictions are division or plant wide and not for a specific job. They should coincide; i.e., don't approve limited use of an arm because of a fracture and then the next week give the person a crane operator's permit.

Be professional, ethical, and stick to medicine. Don't approve above the employee's capability, particularly a new hire. You could make a failure out of him or get him injured.

Dollar benefits to an employee must not influence any opinion of his actual medical condition. Be fair, firm, and don't be afraid to say "no" if the medical facts don't warrant the request of the employee. Be a medical advisor, not a labor relations or insurance representative.

Be available for prompt consultation. Maintain regular work schedules to avoid patient lineup and also to enable the PC and supervisors to know when to contact doctors regarding placement problems.

Know the plant—visit the plant. Remember to give medical opinions and not job assignments. There is a difference! Know the plant management personally. Their support and cooperation is essential. Personal association helps.

Following is an outline of the placement coordinator's duties and qualifications. The PC assigns restricted employees by checking the medical restriction. He must use only those of the plant physician. Placement is accomplished by first determining available jobs and seniority. This requires a good knowledge of the plant and jobs. Instant communication by radio is es-

essential for the PC. In our system, the employee can be processed through employment, medical, PC and job assignment in less than one hour.

The PC maintains daily contact with the employment department, medical, workers' compensation, labor relations, and the U.A.W. He does most of bargaining, instead of the foreman, on job placement where medical restrictions are involved. He maintains statistical records on employees he assigns jobs to and monitors weekly termination lists, W/C lists, and layoff lists to see if he can place these people on jobs. Specific employees are checked daily to see if they are working on the assigned jobs. Job descriptions are provided to the medical department for T & PD cases.

The attitude of a placement coordinator is the most important asset in the placement function. The individual must be enthusiastic and have a positive attitude about placement activities. It is also essential that the PC be

able to work with and handle people problems involving supervisory personnel, service department personnel, union representatives, and employees.

In summary, the PC system may not be all things to all people, but it's a system that can be applied in an orderly and consistent manner to all employees. All it requires is that each department do its assigned task in a prompt, cooperative manner. This includes the safety engineers, who can now concentrate less on records and more on what's best for the employee. A humanitarian point of view, if you will, but the proper point of view because it's right; and with a placement coordinator to coordinate the efforts, the final result will be a properly assigned, fully productive, and above all, a safe worker instead of an absentee statistic. Generally, a productive worker is a happy worker, and when he's happy, the union's happy and so is the company. I guess that's what it is all about.

Automotive, Tooling, etc. Sessions

EXPLORING NEW HORIZONS ON PLACEMENT OF THE HANDICAPPED

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As a member of this committee and General Supervisor of Safety for Oldsmobile Division G.M.C., I feel we must share our experiences in every facet of safety to provide rapid growth in a complex responsibility to all people. My presentation will concern placement of the handicapped in industry and business.

Already you are probably thinking: What has placement of the handicapped to do with the safety activity—that job and all its related problems belongs with equal employment opportunity managers or directors of human resource management.

Well, you're right to some degree; however, each of us carries a responsibility in decision-making, and in order to make sound decisions we must be knowledgeable about the subject or situation on which we are to make that decision. Based on that responsibility, we then each have a very important role in meeting the objectives for placement of the handicapped. If we show an apprehensive attitude or over-concern for the safety of a handicapped person, we may close the door on their being given an opportunity to be placed in competitive employment.

As members of safety management in industry, business, or placement agencies, we will be looked to for direction and guidance, therefore, our placement programs for the handicapped will be only as productive as we allow them to be. Keeping an open mind to what the handicapped have to offer and providing them an opportunity for employment are the two main keys to a successful program. Let me share with you our placement program on a segment of the handicapped.

Origin of the Oldsmobile Division Blind Employee Placement Program

reaches back into history some 31 years, to August 12, 1946. In that year, Oldsmobile Division placed their first blind employee by embarking on an active recruiting and placement program, for the blind. From that date on, this venture has been a very productive one. Without question, much of the credit must go to those originally-placed blind persons, because without their successes in performance on a competitive basis, growth and longevity would not have been realized. The industrially blind employees at Oldsmobile have unequivocally proven their abilities and paved the way for many others in industry and business.

This presentation was prepared for three basic reasons:

1. To share with you information on a successful blind placement program.
2. To broaden your perspective on job availability for the blind.
3. To instill in you the desire to explore new horizons, on placement of all handicapped individuals.

The Oldsmobile Division is a parts fabricating division as well as an assembly plant, producing gas and diesel engines in their engine complex; sheet metal and plastic components; painted automobile parts; full assembly of automobiles; chromium plated parts; forge and foundry operations; and differential machining and assembly.

In General Motors we recognize both the blind person seeking employment on their own and the person referred by the State Division on Services For The Blind. The latter, of course, is preferred, as the referred blind person has already acquired some additional knowledge in mobility training, placement evaluation, and in many cases dexterity training.

From this step on placement is rather simple; the blind person goes

through the same medical examination and employment procedures as their sighted counterparts. Needless to say, they have all the same privileges in pay, benefits, and opportunities.

Keep in mind it is not our intent to make a job to fit the blind employee's capabilities. In all cases they must be competitive in performing an already established job. Locating the job is one of the key elements in a successful placement program.

As a general rule, guide dogs are not allowed into the plant. The blind person must have the capability to get to work, travel from the gate or parking lots, ring their own time card, travel to their assigned job through the plant, and go to the rest rooms, first aid stations, and lunch rooms unassisted. In order to allow the blind person the protection they need from mobile equipment or other pedestrians and in finding their way in the plant, the use of a white cane while on plant property is mandatory. Canes are furnished by the Division as a required safety device. Presently, Oldsmobile has 19 industrially blind employees working.

In the description of the blind employee, terms such as 20/200 vision or 20/400 vision will be used. What this means is what you can see at 200 feet with good vision, the blind person must be within 20 feet to see. A legally blind person has corrected visual acuity no better than 20/200 or a field of vision defect, restricting vision to less than 20 degrees, like shotgun or tunnel vision, or no central vision.

Donald Hicks has 20/200 corrected vision in his right eye and is totally blind in his left eye. He began his employment in June 1952. His job is to assemble a spring stiffener into a radiator hose. This is accomplished by first dipping the end of the spring into a soap solution in a pan on the bench, then shoving the spring into the radiator hose with a twisting action, and finally placing the completed assembly into a carton for delivery to the car assembly line.

Charlie Ulrick, with 20/200 corrected visual acuity in both eyes, performs the same operation as Donald Hicks. In September 1962 he began

work in our engine complex and since transferred into the small parts final assembly group. Insertion of the spring stiffener into the radiator hose is expected at the rate of 160 per hour.

George Ellena is totally blind. He was hired in August 1960. In our engine component assembly complex he machine assembles water pump impellers and bearings into the machined water pump casting, using two-hand control palm buttons for cycling the machine. He is required to put up all his own stock for the operation, such as baskets of impellers directly behind him and the bearings to the right of his machine.

Russell Watson has 20/200 vision in his left eye and is totally blind in his right eye. His seniority goes back to August 1970. His current job is to secure the bolt to the harmonic balancer on the engine crankshaft and remove the slave guide pin used in assembling the balancer. This line operates at nearly 300 pieces per hour, and a phase of his operation is to trip an air valve to allow the line to index each 10-12 seconds.

Howard McCumber has tunnel vision and a marked loss of hearing. He was employed in May 1951. He stocks carburetors to the engine dress-up assembly line. A portion of this operation requires him to sub-assemble hoses to the carburetors. On some of the carburetors he is also required to assemble a fitting by use of an air tool.

Totally blind, Thomas Munn joined the Division in December 1976. He works on our engine dress-up assembly line, a monorail conveyor which runs at nearly 250 engines per hour. He installs the gas line between the carburetor and the fuel pump.

Operating mechanical power presses, William Mahaney has visual acuity of 20/400 in both eyes. He was hired in March 1977, and is the Division's first blind classified mechanical power press operator. He loads the die with tongs, then cycles the press with dual control palm buttons.

Morley Schram, with vision of 20/400 in his left eye and light perception only in his right eye, was hired in May 1977 and is classified as a conveyor

Automotive, Tooling, etc. Sessions

he is responsible for machine quality, production, and feeding of parts.

Lindell Kositzke, with 20/200 vision in both eyes, began work in May 1977. Within the bumper plating department he is classified as a conveyor attendant. His responsibilities involve servicing three separate conveyors, one bringing automobile bumpers to and from the job and two other fixture-type bumper-polishing conveyors.

With continual and gradual loss of vision, Barbara Yerke has a current visual acuity near 20/200 in both eyes. Her seniority dates to August 1977. She is presently classified as a conveyor attendant, carrying engine piston and rod assemblies and stocking trays of piston sets to the float conveyor.

Raymond Bronson has corrected vision of 20/200 in both eyes. His employment date reaches back to March 1953. He works in the small parts sub-assembly department, loading a riveting fixture and cycling the fixture to rivet the exhaust system bracket and rubber hanger together.

With 20/200 vision in both eyes, Tom Alman works as a conveyor attendant. As a new employee in May 1978, he removes finish-plated automobile bumpers from the monorail conveyor.

Our most recently placed blind employee opens yet another door in exploring new horizons. He is the first blind employee to be assigned to our forging plant operations, beginning in June of this year. His name is Robert Thomas, and his duties include obtaining a billet from the hopper and tending an induction heater. His vision is 20/300.

Operations or job assignments which have been previously assigned to industrially blind employees include: operate hand press fixture to set dynamic pulley balancer on engine; perform assembly of ring gear and bolts to differential case; run riveting fixture for sheet metal sub-assembly; load and unload parts washer with varied sheet metal stampings; programmer and computer read-out operator in data processing; hand assembly of rubber brake pad to automobile brake pedal; torquing and se-

attendant, loading and unloading the moving monorail conveyor with axle shafts to maintain adequate machining floats.

Floyd Geer sees only shadows, as his visual acuity is near total blindness. His career began with Oldsmobile in February 1954. He performs many varied bench assembly operations in the small parts assembly department of the car assembly plant, such as assembling the bright metal ring onto the shift lever knob.

Without vision in either eye, George Leonard began work with the Division in March 1976. Currently he is setting up and transferring differential primary gear assemblies from one conveyor indexing line to the next. Strength, dexterity, and a sense of direction such as he has is needed to travel between two indexing assembly lines with both hands full.

Bill Campbell also has no vision. Beginning work in April 1976, he works on the primary case indexing assembly line, where he is required to assemble the cross shaft and secure same with assembly of a bolt, using a suspended overhead air tool to secure the bolt. Putting up his own stock and determining which of several parts to use on different assemblies is also a part of the job.

George Macut has partial vision (light perception) in his right eye and corrected vision of 20/200 in his left eye. In March 1953 he was employed by the Division. One of his jobs is wiping oil off of the sheet metal fenders on an "A" frame conveyor. This is done to provide a cleaner fender for which the inspectors up-line can inspect for dings or metal imperfections.

With corrected vision of 20/200 in both eyes, Larry Fish was hired in October 1965. He currently sub-assembles the gas tank strap screw by use of an assembly fixture, with automatic feeding of the screws. By placement of the gas tank strap end into the fixture, an air-powered screwdriver then drives the screw into the strap.

Dennis Johnson has corrected vision in both eyes of 20/200. His seniority dates back to January 1966. As a crankshaft milling machine operator

curing gas line on engine assembly dress-up conveyor; repair ream and tap parts on single spindle drill press; provide janitorial service to a section of office area; operate a stock elevator in a car assembly complex; sub-assembly oil pump shaft by use of hydraulic fixture; automobile power steering sub-assembly; sub-assembly of mounting bracket and brake pedal.

The list, of course, could be endless and we hope this program ongoing at one of the General Motors plants has given you some insight on an element of what the handicapped, blind, have to offer.

Let the blind help explore new horizons concerning what they can offer in competitive employment. Oldsmobile Division employs other handicapped individuals, including but not limited to persons restricted due to physical ailments. Some 820, in fact. Of 1,787 new employees hired last year, 59 were handicapped.

In closing this presentation, we would like to share with you a short part of one handicapped's experience in working at General Motors Oldsmobile Division: Paralyzed from the waist down due to a snowmobile accident a few years back, this employee previously worked on salary as a draftsman and from his wheelchair today continues to work at that job. His name is Dick McAvoy.

For some time after returning to the job after his accident, the only way he could reach the second floor office and his drafting area was by way of a freight elevator, as no passenger elevator existed in the complex, only escalators, stairs, and freight elevators.

This eager young man, not wishing to be set apart from his fellow workers

on reaching the second floor, decided to explore riding the escalators in his wheelchair. But before he attempted this maneuver he searched the country for a training program and found one offered at Rehabilitation Institute in Englewood, Colorado. He attended this program and learned to safely ride on escalators with his wheelchair.

Upon his return to work and minor rework of narrowing the wheelbase on his wheelchair, he requested approval to use the escalators. After discussion and demonstration, the Division's safety management and upper management in Personnel and Product Engineering approved his use of the escalators.

He approaches the escalator in a forward position for the ride up. Reversing that position, he rides the escalator down in a backward position.

Conclusion

Any one of us could wake up tomorrow with retinal detachment, totally blind. We each then would hope to God someone in industry or business would have an attitude toward the handicapped supporting the fact that they are not incapable. In nearly all cases, once a person has been trained to cope with their physical disadvantage, only a little special attention on placement is needed.

It is hoped that each of you will promote the placement of handicapped persons in the future and let them explore new horizons with you on their capabilities.

A final thought I would like to leave with you is this: If you searched the whole world over you would find a person with a handicap doing nearly every kind of job.

THE ROLE OF THE REHABILITATION COUNSELOR IN A SELECTION & PLACEMENT PROCESS

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Blindness, when it occurs, is an experience that can't really be shared with anyone. If it happens to you, no one, no matter how close or who they are, can share your pain, anxiety, bitterness, or all the other feelings of worthlessness, helplessness, dependence which are part of the loss you experience. In the same way, you can never share or comprehend what a friend or a family member is experiencing if it happens to them and you are the bystander.

Just a few minutes of imagining what life would be like without sight brings on an almost instant depression, anxiety, and fear. My efforts during the next few minutes will be to alleviate such feelings rather than to heighten them.

I have been legally or, if you will, industrially blind since early childhood. I have been functionally totally blind for approximately the last 25 years. You may ask, what is the difference? Since time will not permit a detailed analysis of the differences, let me give you some examples from my own personal experience. I remember at age 8 or 9 sitting on the seat of a car in front of the driver and steering the car down a two-lane driveway. At the same time I remember seeing cars top the next hill down the road as far as one-and-one-half or two miles away. I remember my typing teacher in high school placing a shield between my eyes and my hands on the keyboard to keep me from seeing the letters on the keys. I remember after graduating from high school attempting to hurry to a factory window to observe a thing of beauty across the street and stumbling over a dolly at my feet before I reached the window.

The point I am making is that we have established so-called definitions of blindness which categorize people in groups for industrial or medical purposes, but these definitions denote little or nothing about the visual functioning of the individual. There is a tremendous deficit in the public understanding of blindness and how blind people meet the demands of living. Many times in the circles of professionals who work in the field of blindness it has been said that the greatest handicap that a blind person faces today is that he is well trained and well adjusted is the public misunderstandings concerning his handicap. Again, let me cite some personal experiences, and while some of these experiences are not particularly pleasant, others are not all that unpleasant, either. Once, while riding on an elevator, which incidentally was not crowded, a gentleman observed my cane, and while we were chatting on our way down to the lobby he asked me if I was headed for the driving range. I can feel good about an experience of this kind. Many times I have been asked if my cane contained radar. By the same token, I become very annoyed and frustrated when my wife and I go into a restaurant and after looking over the menu together, the waiter or waitress comes to the table and I give them the order for the both of us; a few minutes later he or she returns to the table and says to my wife or any other sighted companion, "Would he like cream in his coffee?" At that point, my standard response is, "No, he hates the stuff, but I would enjoy having some, please."

My favorite story, incidentally, is an actual experience. Two blind men who

were friends of mine happened to encounter each other one evening on their way home from work. As they walked home that evening they touched each other's arms and rhythmically arched their canes back and forth while they chattered with each other. They were completely unaware that they were being very closely observed by an elderly school teacher who was walking just a few steps behind them. When the two men came to a corner at which their routes parted, they very conventionally said, "Well, so long, it's been nice seeing you." Just a few steps farther on one of the men felt a tug at his sleeve by the elderly school teacher. She said, "Pardon me, but aren't you blind?" "Why, yes, I am," was his reply, "why do you ask?" "Well, I have been following you for sometime and I was confused when you told your friend that it was nice seeing him again." The blind man smiled, leaned forward and said softly, "But ma'm, what would you have thought if I had said it has been nice feeling you?"

Sight, or the visual sense, is but one of several sensory systems that man uses to perceive his environment and himself within it. Man uses his vision to make seven distinct perceptions. Through his eyes he perceives light and color; other perceptions of field, imagery, depth, form, and motion are also possible through the visual sense. The question then arises, when the visual functioning is lost, to what extent can these same perceptions be compensated for through the other senses. A very quick analysis reveals that, with the exception of light and color, all other visual perceptions are compensated in whole or in part by no more than two of the remaining senses. The first of these, of course, is the sense of hearing. If we listen closely, we can gather data about our environment which the brain can process that will compensate for, in whole or in part, five of the seven visual perceptions. Couple the sense of hearing with the sense of touch and we greatly expand the compensatory qualities. In addition to the sense of touch and hearing, many persons possess some additional faculties which are not nor-

mally regarded. Let me try to explain. If I place my hand on an object such as a table top, immediately through my sense of touch I can determine temperature, texture, density, and moisture. Nothing more. But if I couple my sense of touch with muscular capacities or motion, I add a completely new dimension to my sense of touch. We call this faculty kinesthesia.

Through kinesthesia, in addition to all the tactile senses, I can make observations about size, weight, and relative position in space as it relates to me and to the environment. Kinesthesia or the kinesthetic sense, then, expands the blind man's ability to function in his environment. There is, however, an additional sense that everyone possesses but is not normally considered by many people. This is what we call vibration.

Vibration is the ability of a human being to mentally visualize scenes or images based upon previous visual experience, and to associate and assemble within the brain pictures of objects, scenes, or activities. If we couple this ability to vibrate with the kinesthetic sense and man's other normally regarded senses, and train him to use all of his capacities effectively, many things become possible. Let me give you one simple example of some of the things I am talking about. Put my hand on a door facing my left hand, if you will, and ask me to place my right hand on the opposite side of that door. If my left hand only touches the flat surface of the left side of the door facing, I must grope through a 360° special radius to find the right side of the door with my right hand. But if you allow me to move my left hand slightly and observe the wall adjacent to the door facing with one finger and at the same time locate the 90° surface around the other edge of the door facing, or in other words if you allow me to use my kinesthetic sense and my ability to visualize and recognize a door facing and to use angles gained through my kinesthetic sense, I can without hesitation place my right hand on the opposite side of the door or move through the doorway into an adjoining room or hall without difficulties. This is a very simple illustration,

but I hope it enables you to understand the point.

When an individual loses his sight he is not miraculously transformed into an acoustical genius with super-tactile functioning. He must, if he is to compete and to adjust to his handicap, learn to use his remaining capacities in a much more efficient manner and thereby develop different techniques for doing or accomplishing many routine tasks. Fortunately, the state of the rehabilitation art is such that the average blind person with adequate training and proper equipment can function today comparatively with equal productivity and safety in the occupation of his choice.

Interest in the employment of blind workers on selected jobs is greater today than ever before. Though blind people have been working in industry in substantial numbers since World War II, you are probably all aware of the reasons for much of this heightened interest in the employment of blind persons, so we will not dwell on that. The key, however, to a successful selective placement program, I believe, is an analysis of jobs to determine accurately and adequately the actual sight requirements of those jobs. The formula for gathering the job analysis information for that purpose must and does include the full considerations in any normal job analysis, those considerations being what the worker does, why he does it, how he does it, and the skills required. In addition to these four considerations, however, the job analysis with respect to blindness must include three additional considerations; these are: How else can the work be done? What additional skills are needed by a blind worker? Can a pattern of safety be followed by him without unduly slowing his production or creating a hazard or barricade for other workers?

To conduct such a job analysis requires skilled personnel from at least two disciplines. These people must and can work together to insure maximum success. One of the individuals involved in the job analysis process needs extensive knowledge about the jobs and the processes involved, and the other member of the job analysis

team must be equally knowledgeable about blindness, blind people, and the techniques and instruments they use to enhance their function ability. In many instances it is necessary to demonstrate or test these techniques and instruments on the job site. Please keep in mind that the purpose of the job analysis is to determine the visual requirements for job performance. The purpose is not to compile a list of jobs that can be done by blind people. Often the analysis will show that no vision is required for job performance. It may, however, be determined that distinction of the difference between white and black or red and green, or the ability to read a label or part number, or to gauge a distance of 2, 6, 10 or 24 inches under given light conditions is a requirement for the job. The blind person then selected for that job must be able to perform those specific tasks.

The final and most important consideration of the job analysis must answer the question: Can it be done safely without sight? To make this consideration, a four-point safety pattern has been developed, and I am unaware of any compensable injury to a blind worker on any job where this pattern is followed. The pattern has been used in the rehabilitation of blind persons for approximately 35 years. It is very simple.

Point 1 involves establishing the point at which a blind person can safely make initial contact with a piece of equipment. For instance, a table saw can be approached safely at any point from table height downward.

Point 2 is the point at which the blind person can determine the state of rest or motion of a piece of equipment, or the observation point. The smooth end of a head shaft or arbor shaft often serves as the ideal point. The blind person can also make observations concerning speed and direction from this point. Caution, however, should be taken in the observation point selection to avoid a point which would be inaccurate due to clutch release or other controls being deactivated.

Point 3 is the establishment of safe paths for the blind worker to move his hands from the point of observation to

controls and back again.

Point 4 in the safety pattern is a safe method of determining the progress of the work being performed by the equipment. This often involves utilizing the blind worker's remaining senses to observe cutting or difficulty in the processing or determining the end of a cycle. Sometimes, for instance, a blind worker can smell hot oil, or hear a change in pitch which denotes slowing down of a cutter or other problems; even a change in vibration can be detected. This pattern of safety can be quickly taught to sighted personnel responsible for safety judgments. This may include foreman, unit manager, or any other individual who needs to make safety observations. This safety pattern will work for all workers, not just for blind workers.

I am absolutely convinced that the rehabilitation counselor is in a unique position to be an extremely valuable industrial resource. I hold this very strong conviction for the following reasons. First, the rehabilitation counselor is a professional charged with the responsibilities for delivering vocational counseling and guidance,

physical restoration, training, special tools and equipment, and job placement services to blind people. For this reason he is in an excellent position to recommend qualified individuals for specific jobs.

Second, with his expertise in the area of visual impairments and blindness and his skills and training in the area of job analysis with respect to blindness, he can give valuable assistance to an employer in the selection and locating of suitable jobs within a plant.

Third, when the rehabilitation counselor and skilled plant personnel are effective, everybody, including you and me, profit. The company makes money, the blind person and their families are benefited, and so on down the line. When, however, the rehabilitation counselor is not effective, we all get cheated. Now, I can tolerate losing a game if I know everybody goes all out in an honest effort to win, but I get damned mad when I know I have been cheated. I sincerely hope that you do not feel that you have been cheated by being a part of this program. I can assure you that I do not.

Power Press & Forging Sessions STOP TIME MEASUREMENT — SEPARATION DISTANCE

By DENNIS R. EBENS
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OSHA requires that when using two-hand trip on full revolution presses, and two-hand control or presence sensing devices on part revolution presses, they be mounted at a certain safety distance. This safety distance is determined by two formulas: one for two-hand trip and one for two-hand control or presence sensing devices. It is the employer's (press owner's) responsibility to determine these safety distances.

The formulas require that the palm buttons or presence sensing devices be placed a certain distance from the nearest pinch point in the point of operation. However, they don't mention or recommend how far apart the palm buttons should be mounted. The reason is that the palm buttons or other actuating mechanisms operated by both hands are not always mounted on the same plane. Also, there are several varieties of ring guards and fabricated shields available to protect the button from unintentional operation. When mounted on the same plane, I recommend that push buttons be 27 inches apart center-to-center. U.L. (Underwriters Laboratory) recommends that they be 22 inches from inside to inside of button. The main consideration should be to insure that an operator must use two hands, and not the fingers and elbow of the same arm, or a forehead, knee, or hip in place of a hand. Quoting OSHA, it says that "each hand control shall be protected against unintended operation and arranged by design, construction and/or separation so that the concurrent use of both hands is required."

OSHA also says, for both full and part revolution presses, that the two-hand trips and control shall be fixed in position so that only a supervisor or safety engineer is capable of relocat-

ing these controls. This means that when the palm buttons are installed it must be in a manner so that the operator or set-up man cannot easily relocate them. Another requirement is that when there are multiple operator stations (more than one operator) they all must be located at the proper safety distance.

The formulas for these safety distances are based on an operator being able to move a hand toward the die at a speed of 63 inches per second. This speed was determined by Dr. Oscar Lobl in Berlin, Germany, in tests made in 1936, and has been used for press safety in Europe for about forty years.

Because we have two subject titles—stop time measurement, and separation distance—we will deal with each separately. Since stop time measurement applies only to two-hand control and presence sensing devices on part revolution, we will leave that until later and first deal with the determination of safety distance when using two-hand trip on full revolution.

Two-hand trip is a clutch actuating means requiring only momentary pressure on the palm buttons by both hands of the operator to start a press stroke. Once the driving member, such as a pin (dog), collar (jaw) or rolling key has been engaged into the flywheel or gear that's rotating, the slide must complete one full stroke before it can be stopped. Two-hand trip can be used as a point-of-operation device only when the palm buttons are located at the proper safety distance so that the operator cannot reach into the pinch point prior to die closing.

To determine the safety distance, we first must use the following formula:

$$D_m = 63 \text{ inches/second} \times T_m$$

Where: D_m = minimum safety distance (inches); 63 inches/second = hand speed constant; and T_m = the maximum time the press may take for die closure after it has been tripped (seconds).

For full revolution clutch presses with only one engaging point, T_m is equal to the time necessary for one and one-half revolutions of the crankshaft. The following is an example for a press operating at 140 spm with one engagement point:

$$D_m = 63 \text{ in.} \times (1\frac{1}{2}) \times \frac{60}{140}$$

$$D_m = 63 \text{ in.} \times 1\frac{1}{2} \times .4286 = 41 \text{ in.}$$

For full revolution clutch presses with more than one engaging point, T_m shall be calculated as follows:

$$T_m = \frac{1}{2} + \frac{\text{number of engaging points per revolution}}{\text{time necessary to complete one revolution of the crankshaft (seconds)}}$$

Before calculating the above formula, you will need to know the strokes per minute (spm) or rpm of the flywheel or gear and the number of engagement points in the clutch. To obtain the strokes per minute, you can refer to the instruction manual for that particular press, contact the manufacturer, or operate the press continuously using a stop watch and counting the strokes. To obtain the number of engagement points, you may again refer to the instruction manual or contact the manufacturer. If this is not possible, then you will have to slide the flywheel or rear out far enough on the crankshaft to see the number of engagement points in the flywheel or gear. Once these things have been determined, you can use the formula.

For example, the minimum safety distance for two-hand trip on a press having a speed of 150 spm and three engagement points would be calculated as follows:

$$D_m = 63 \text{ in./sec.} \times (\frac{1}{2} + \frac{3}{3}) \times \frac{60}{150}$$

$$D_m = 63 \text{ in./sec.} \times .4 - 20.999 \text{ or } 21 \text{ in.}$$

Another example with a press having a speed of 110 spm and 14 engagement points would be calculated as

follows:

$$D_m = 63 \text{ in./sec.} \times (\frac{1}{2} + 1/14) \times \frac{60}{110}$$

$$D_m = 63 \text{ in./sec.} \times (.57) \times .545 = 19.57 \text{ or } 20 \text{ in.}$$

Rather than go to all the trouble of calculating the distance for each press, the data has been reduced to a chart. After reviewing this chart, it becomes obvious that it is generally not practical to consider using two-hand trip unless the press is operating at 120 spm or more.

Before getting into two-hand control on part revolution presses, we should point out that two-hand trip could also be utilized for part revolution. This may be done when there is not enough holding time (on the cams in rotating cam switch) during the die-closing portion of the stroke to qualify the installation for two-hand control. The safety distance for such a two-hand trip is $63 \text{ in./sec.} \times (\frac{1}{2} + 0) \times \text{time of one crank revolution in seconds}$. The reciprocal of the number of clutch engaging points can be considered as zero, because a part revolution clutch can be engaged at an infinite number of points and there is no significant delay between tripping and engagement. If the stroke is started with the slide at top center, not more than half a stroke can occur before the dies are closed. The formula can be simplified into $63 \text{ in./sec.} \times \text{time in seconds required for one half of a stroke}$. If a part revolution clutch press has a speed of 60 spm, the time of one crank revolution is one second, so the time of the die-closing half of the stroke is one-half second. Sixty-three inches safety distance. Slower speeds would make the use of two-hand trips on part revolution presses rather impractical.

We mentioned before that the other formula was used when two-hand control or a presence sensing device is used on part revolution presses. It is important to remember that these two devices can only be used on part revolution clutches or on machines with equivalent operational characteristics that permit stopping the slide at any point during the stroke. At the same time the clutch is disengaged, the brake

must be applied.

The formula for mounting the two-hand control or presence sensing device at the proper safety distance on part revolution presses only is as follows:

$$D_s = 63 \text{ in./sec.} \times T_s$$

Where: D_s = minimum safety distance (inches); 63 in./sec.—hand speed constant; and

T_s = stopping time of the press measured at approximately 90° position of the crankshaft rotation (seconds).

Before calculating the safety distance, we need to determine the stopping time of the press at approximately 90° rotation of the crankshaft. To accomplish this, a stop time measuring device is usually used.

At this point, we are going to divert our thinking for a short while to stop time measurement to get this stopping time. A portable device is usually used. It consists of a slide attachment of some type that is temporarily secured to the slide. This attachment operates a transmitter that supplies information to a receiver, and a readout in milliseconds is obtained. A typical test sequence for one type of equipment would be as follows:

1. Place the transmitter unit on the bolster plate close to the slide, but with positive clearance.

2. Place the slide attachment on the slide so the drive pin fits conveniently between the follower pins on the transmitter.

3. Connect the transmitter to the receiver via its electrical cord and connector. Either plug the receiver cord into a special receptacle mounted in a control box, after removing the shorting plug, or tie-in to the emergency stop of the press by either going into the control box or emergency stop button.

4. Check the receiver to make sure that everything is operational.

5. Set press control for single stroke or inch mode of operation and cycle press to determine slide stroke. On this unit, the red pointer travels with the slide and will define press stroke. Set the white pointer at half-stroke or approximately 90° position of crankshaft rotation, which is represented by

the inch mark 8. This adjustment pre-sets the exact angular position in the press cycle where stop-action will be signaled.

6. Initiate the press holding the initiation means (palm buttons) depressed. The press will then stop automatically at 90° and the actual stopping time in thousandths of a second (milliseconds) will be displayed on the digital readout. It is suggested that several readings be taken (8-10), and the highest one used in computing the actual safety distance.

For example, after taking several readings of which the highest was .230, it would calculate as follows:

$$D_m = 63 \text{ in./sec.} \times .230 \text{ seconds} = 14.49 \text{ or } 14\frac{1}{2} \text{ seconds}$$

As you can see, the calculation is quite simple; however, for quick, easy reference, there are charts which show the maximum time for each half-inch of safety distance.

Other factors that could cause the press not to stop normally, other than brake deterioration, would be air line restriction, hose crimping, air pressure variance, dirty muffler, variance in speed of press, or an undersized solenoid valve. On numerous occasions, we have had customers find that the solenoid valve they were using on a large (250-ton or larger) press was too small. By installing a larger capacity valve they were able to considerably decrease stopping time. Faster stopping times could be acquired by using quick dump valves, larger piping and hoses, and by using two valves on presses that have the clutch and brake in a split application.

The 90° position of the crankshaft was selected to check stopping time because at that point the slide of a mechanical press moves downward at maximum speed. It was felt that in this position, the stopping time would be at its maximum because the weight of the slide and its attachments. Tests on some presses have now indicated longer stopping times at top center than at midstroke, and in every case the maximum stopping time must be used for determining the safety distance. It was theorized that the reason for better stopping ability at 90° than at top was that the air that would fill

the clutch mechanism cavity, diaphragm, or tube was not completely full at 90°. Therefore, the clutch springs also would not be completely compressed, resulting in less air volume to dump and thus the ability of the press to stop quicker. Another consideration when testing the press for stopping ability should be the temperature of the brake. Is it hot or cold? When it is one or the other, it may cause variance in stopping ability. Once again, maximum stopping time conditions should be used to determine safety distance.

Obviously, many things have to be kept in mind when testing the press. We suggest that the worst (or longest) time be used for calculating the safety distance, since this will always provide the safest conditions.

Now that we have established the safety distance, we can mount the two-hand control or presence sensing de-

vice (light curtain or radio frequency) on the press. When mounting any of these devices, please keep in mind that sides and back of the die area that are not protected must also be guarded, and this is usually accomplished with barrier guards.

OSHA also requires, when using a two-hand control or presence sensing device, that the press control comply with paragraphs (b) (13) Control Reliability, and (b) (14) Brake Monitoring.

I suggest that every possible effort should be made to provide dies and feeding methods, especially new dies, so that the operator never has to place a hand in the point of operation. This applies to both feeding and removal of parts and scrap. Remember: complete operator safety is our ultimate goal, and no hands in the die area is the only positive way to provide this protection 100 per cent at all times.

CONTROL RELIABILITY FOR PART REVOLUTION CLUTCH PRESSES

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The Occupational Safety and Health Standards, as revised in the December 3rd, 1974 *Federal Register*, allow "hands in the die" operation with presence-sensing devices, two-hand control devices, or a type "B" gate device when the press control system includes 1910.217 (b) 13, Control Reliability, and (b) 14, Brake System Monitoring.

Control reliability is defined by OSHA as follows: "The control system shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the press when required, but does prevent initiation of a successive stroke until failure is corrected. The failure shall be detectable by a simple test, or indicated by the control system. This requirement does not apply to those elements of the control system which have no effect on the protection against point of operation injuries."

To fully appreciate the goal of the control reliability requirement, one should also be familiar with the prerequisite requirements:

(b) 7 (xi) reads in part: "The control of air-clutch machines shall be designed to prevent a significant increase in the normal stopping time due to a failure within the operating valve mechanism, and to inhibit further operation if such failure does occur."

(b) 8 (v) reads: "All clutch/brake control electrical circuits shall be protected against the possibility of an accidental ground in the control circuit causing false operation of the press."

(b) 8 (vi) reads: "Electrical clutch/brake control circuits shall incorporate features to minimize the possibility of an unintended stroke in the event of the failure of a control component to function properly, in-

cluding relays, limit switches, and static output circuits."

The language of these requirements sets the pace for control reliability. The ground protection and control component failure requirements ask that no one single failure in the control should cause a false or unintended operation. The air valve requirement and control reliability go one step further. A faulty air valve must not only stop the press safely, but further operation must be inhibited. A faulty control with control reliability must still apply normal stopping action when required but, in addition, must prevent initiation of a successive stroke until the fault is corrected.

Clutch Control

Regardless of the complexity of any particular press control system, it is the single stroke clutch control portion of the press control that demands attention when control reliability is required. Pressure switches, stop buttons, motor interlocks, etc. are required, but they must operate only occasionally. These devices should be checked by actual test on a regular basis. However, the run buttons, relays, clutch and brake air valve, and rotary cam limit switches must perform each of the many millions of cycles during the life of a press. OSHA doesn't expect those operations to all be flawless; quite the contrary. Failures are anticipated; however, control reliability requires that a failure be recognized, that the failure does not prevent a normal stopping action, and that initiation of a successive stroke is prevented.

After satisfying all the prerequisites of single stroke operation, such as starting motors, selecting the mode, etc., a typical single stroke of a press

is comprised of the following:

1. An initiating portion of the cycle, where each operator depresses and holds a pair of run buttons until the dies have nearly closed.
2. An automatic or take-over portion of the cycle, where circuits are sealed around the run buttons by relay and rotary cam limit switches contacts and, depending on the circuit design, perhaps motion detector and/or air valve limit switch checking contacts.
3. An anti-repeat control sequence near the end of the cycle, where rotary cam limit switch contacts are used to cause the circuit through the run buttons to open and prevent them from continuing the cycle beyond the normal end of the stroke, even though they are held depressed.
4. A stopping portion of the cycle, where again rotary cam limit switches are used to open the sealing circuit that was established around the run buttons.
5. A checking or reset control sequence that looks at critical contacts in the control circuit before permitting another press stroke to be initiated.

Actually, the reset control sequence occurs at the start of the cycle, where a check is made that run buttons, run relays, stopping cam limit switches, air valve checking limit switches, motion detector, etc., if and as used, have all dropped out, tripped, or reset to their normal condition. In other words, this reset control sequence checks the circuit to prevent initiation of another stroke if a component has failed. The methods and circuits used vary with the designer. Some circuits follow a symmetrical redundant approach, others are nonsymmetrical. All include some form of self-checking and are designed with fail-safe in mind, fail-safe at least in the sense of de-energization to stop or safe condition. In general, then, the most common methods of obtaining control reliability are by use of redundancy and/or self-checking circuitry.

Redundancy

Prior to the adoption of 1910.217 and its original effective date in August 1971, simple redundancy was often used by press control circuit de-

signers to improve control reliability in the clutch control. Since 1970, the use of redundant circuit design has become widespread and more complex. By doubling up relay contacts, limit switch contacts, relays, or other components, the odds against circuit failure are vastly improved. One simple illustration of redundancy is use of two contacts of the same relay. The failure of either contact to open, will not cause the solenoid to hold in. The odds of two contacts welding closed at the same instant are very remote. Another arrangement consists of use of two relays. If one relay fails to drop out, the circuit still opens and drops out the solenoid. The chance of both relays failing to release at the same time is also very remote. Why not independent circuits to operate each of the relays? Why not independent solenoids operated by contacts on both relays? Even with these simple examples, it is easy to see how, in ever-increasing complexity, the circuits grow. However, redundancy does contribute to better control reliability and has been used quite extensively on automotive press control circuits for years.

Redundancy is also used in a mechanical sense, such as in dual air valves, and also to improve rotary cam limit switch drive reliability. When a chain drive for the rotary cam switch is used it should be a double chain, based upon the principle that two chains will not fail at the same time. A broken chain must be replaced immediately to continue operation of the press with the same degree of reliability. An improvement of this concept would be the use of separate rotary cam switches with separate drives. A failure of either switch to turn would stop the press.

These are all examples of improving the odds in favor of control reliability. Redundancy, in itself, is not a 100 percent guarantee. Some form of fault detection is required.

Check Circuitry

Another method of improving control reliability is by the use of checking circuitry, not necessarily all electrical. A simple example is incorporated in

press control rotary cam limit switch drive. Care must be taken to insure the reliability of this drive. Several methods are used to accomplish this, including the redundant double chain drive and the use of two separate drives mentioned earlier. Checking methods are also used. Chain breakage can be checked by using a spring loaded idler sprocket to actuate a limit switch, so that when the chain breaks the switch will open and in turn stop the press. Another method incorporates a limit switch built into a hinged bracket that supports the rotary cam limit switch; when the chain breaks, a spring under the hinged bracket moves the bracket, operates the limit switch, and stops the press.

For years, some press builders have monitored the rotation of the press control rotary cam limit switch with a motion detector. This can be a zero speed switch coupled to the switch shaft extension through a gearing arrangement to speed it up, or it can use a pulse generator built into the rotary cam limit switch or mounted on the shaft extension to signal an electronic device whenever the cam shaft is rotating. The circuit is usually arranged so that when the pulses stop, such as when the driving means fails, the press will stop, as soon as any of the run buttons in the circuit are released.

Use of the drive failure motion detector has a distinct advantage over a chain drive fault detector in that it must operate each stroke of the press and therefore can be checked for pick up and drop out each stroke of the press.

In the clutch control circuitry, normally open and normally closed contacts of relays and limit switches are used as required by the particular circuit to check for and insure a proper sequence of operation. One relay contact can be used to check the operation of another relay, or a rotary cam limit switch contact can be used to check the operation of a relay. By a careful selection of relays, relay contacts, and limit switch contacts, blended with redundancy and/or circuit checking, a circuit designer can build reliability into the clutch and brake controls so that the first component failure is rec-

the double solenoid valves used in clutch and brake controls. The two valves are redundant; however, without a checking arrangement, the failure of one valve may not be easily detected. If one valve hangs up, the failure of the second valve could cause a malfunction of the press.

In one form of a parallel flow dual valve, designed specifically for press use years ago, oversize exhaust poppets are used in conjunction with a surge tank and somewhat restricted air source. When one side of the valve fails, air is exhausted thru the other side to stop the press, and at the same time blow down the air in the surge tank. Loss of pressure is sensed with a pressure switch, to shut down the main drive motor and stop further press operation.

In another form of a parallel flow dual valve, a balanced spool in the valve body monitors the valve operation. When one valve fails, the spool shifts and prevents further operation until the valve is reset. Air in the system is exhausted through the other valve to stop the press.

In one form of a series flow dual valve, extensions are provided on the valve stems to operate limit switch contacts. These contacts are wired into the clutch control circuit in a manner that causes the control to check on the proper functioning of the valves and prevent initiation of a successive stroke upon failure of either valve.

Regardless of the valve chosen, the proof of the matter lies in actual performance. Not all dual valves are suited for all press applications. A test should be made periodically, under safe conditions, by intentionally maintaining one side of the valve energized at the end of the stroke, determining how much additional stopping travel occurs and determining whether the press can be restarted before correction of the fault. The test should be repeated for the other side of the valve. The results prove whether or not the valve used is reliable.

If it takes a reliable air valve to stop a press, then it takes reliable control of that air valve as well. One of the most vulnerable parts of the system used to control the air valve is the

organized. It is doubtful, however, if a press control will ever be built that will recognize every failure of each individual contact in the circuit.

Construction

Presses in many instances, depending on the type of job being performed, are subject to shock and vibration. Those elements of the press control that are mounted directly on the press can be affected by this shock and vibration, and in cases where nuisance tripping can occur, shock mounting of the equipment must be considered. Components used in a press control system should be carefully selected to minimize down time, as well as contribute to better control reliability. It is not advisable to use telephone type

relays or stab connectors of any sort. Flush, recessed, NEMA 12 construction and oil tight devices should be used with all external panels.

It is easy to understand that a press control system that meets all the OSHA requirements is very sophisticated when compared to many pre-OSHA press control systems, and it does cost more. The space required for these controls is certainly larger, and the trouble shooting of control failures of this equipment requires better-trained electricians. Despite these new problems, we have little doubt that the improved reliability of these controls will contribute a great deal to safety and are well worth the time and effort that has gone into their development.

POWER PRESS CONSTRUCTION REQUIREMENTS

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Standards

OSHA general industry safety and health standards have specific construction requirements for mechanical power presses, as well as general mechanical and electrical requirements that apply to presses and other industrial equipment. The construction requirements applying specifically to mechanical power presses are listed in part (b) of OSHA Section 1910.217 and are based mainly on the provisions of American National Standard B11.1-1971, Section 8.

Hazards caused by the rotation or movement of flywheels, gears, belts, chains, and other mechanical power transmission apparatuses are common to many power-driven machines. Section 1910.219 of the OSHA standards, based on ANSI standard B15.1, calls for these hazards to be shielded from employees by protective covers and specifies permissible openings, minimum thicknesses of material, and other pertinent details for the covers. Generally, apparatus located so that any part is seven feet or less above the floor level must be shielded. Flywheel covers and their mounting brackets must have sufficient strength to hold the weight of the flywheel in case of shaft breakage.

Paragraph (b) of OSHA Section 1910.212, entitled "General Requirements for All Machines," states that machines designed for a fixed location shall be securely anchored to prevent walking or moving. Most presses are designed for a fixed location, although some, particularly in automotive stamping plants, are intended to be portable.

In addition to the electrical requirements of OSHA Section 1910.217(b), all electrical installations and repairs made after March 15, 1972 must comply with OSHA sections 1910.308 and

1910.309. These sections adopt the National Electrical Code by reference, but with a different definition of the word "approved," for all installations, changes, and repairs made after March 15, 1972. The National Electrical Code defines "approved" as "acceptable to the authority enforcing this code." This is generally a state or local electrical inspector. OSHA defines "approved" as "acceptable to OSHA" and goes on to generally require all equipment to be listed, labeled, accepted, or certified by a nationally recognized testing laboratory such as UL in order to be acceptable.

Article 670 of the National Electrical Code refers to Electrical Standard NFPA 79, which specifically covers electrical installation requirements on all metalworking machine tools, including presses.

There is no OSHA or ANSI requirement that electrical or pneumatic equipment comply with JIC standards. This is up to individual purchasers, press builders, and control manufacturers, the same as compliance with various corporate standards.

The construction standards in OSHA Section 1910.217 and ANSI B11.1 apply to all types and sizes of mechanical power presses, whether floor mounted or bench mounted, but do not apply to similar machines, such as hydraulic and pneumatic presses, press brakes, shears, iron workers, cold headers, forging machinery, bulldozers, welding presses, high energy rate presses, riveting machines, fastener applicators, eyeletting machines, nibblers, platen presses, powdered-metal presses, envelope manufacturing machines, clinkers and dinkers, hot isostatic presses, and printing presses. Most of these machines have their own ANSI standard or have an ANSI standard in the process of being completed.

Forging machinery, including hot trim presses, is covered by ANSI Standard B24.1 and by Section 1910.218 of the OSHA standards. Cold trim presses come under the mechanical power press Section 1910.217, and since the same press can be used for either hot or cold trimming, I recommend that all trim presses be brought into compliance with the construction requirements of 1910.217.

Types of Presses

Mechanical power presses are usually classified by their type of frame construction, the basic types being straight side with rectangular uprights on each side of the slide and bolster, and gap frame with a C-shaped body that provides an open space on each side of the slide and bolster. The most common type of gap frame press is the open back inclinable, or OBI for short, with the frame mounted on a cradle-like base with legs that permit the frame to be inclined backward to permit the loading and removal of workpieces by gravity.

Construction standards do not vary according to frame type, however; requirements are determined by the type of clutch and by the modes of operation for which the press is intended. Two types of clutches are used on mechanical power presses. They are referred to as "full revolution" and "part revolution" because of their characteristics, which are quite dissimilar and which produce different press operating characteristics. Because of this, point of operation safeguarding methods as well as construction requirements are different for the two types of clutches.

Full Revolution Clutches

A full revolution clutch, when tripped, cannot be disengaged until the crankshaft has completed a full revolution and the slide has made a full stroke. The foot pedal or other tripping arrangement generally releases spring pressure to bring together clutch engaging members, which by design must complete a full revolution before they can be disengaged. The disengagement is normally done by a throwout cam arrangement which is

part of the clutch mechanism.

Pins, blocks, keys, or multiple jaws are commonly used as engaging members. These clutches are sometimes referred to as positive clutches because there is positive engagement. Not all positive clutches are full revolution, however, as a few multiple jaw clutches can be disengaged during a stroke.

Part Revolution Clutches

A part revolution clutch can be disengaged at any point during the revolution of the crankshaft or other driving mechanism and at any time before or after the slide has completed a full stroke.

Most part revolution clutches have friction discs that are engaged by air pressure acting against springs that disengage the discs when air is shut off and exhausted. An electrically operated, normally closed, three-way air valve is used to control the flow of air into and out of the air cylinder or diaphragm that actuates the clutch.

Some part revolution clutches have hydraulically-actuated friction surfaces. Others have no friction surfaces and use electrical eddy currents for coupling the driving and driven members. Some early designs of friction clutches were actuated by manual levers or by direct current magnets.

Construction Responsibility

New installations of presses, and this includes old presses moved to new locations, have been required by OSHA to comply with the construction standards in Section 1910.217(b) since August 31, 1971, except for the control reliability and brake monitoring paragraphs (b) (13) and (14), which had a compliance date of November 1, 1975, and are required only if operators place hands in dies when inserting or removing work.

Presses installed prior to August 31, 1971 should have been brought into compliance with the OSHA regulations by August 31, 1974, except for requirements that weren't issued until later. It's the responsibility of any reconstructor or modifier of power presses to do so in accordance with OSHA Section 1910.217. Final responsibility for all installations in a plant rests upon

the employer, however.

When checking for compliance with regulations, it's helpful to also use the ANSI B11.1 booklet, because it has helpful explanatory paragraphs not found in the corresponding OSHA standards. Here are some of the construction provisions that are not always completely understood.

Brakes

The braking system for the slide (or ram) must be capable of stopping slide motion quickly when the clutch is disengaged. The brake must also be able to hold the slide and upper die in place at any point in the stroke and be inherently self engaging, requiring power or force from an external source, such as an air cylinder, to cause disengagement. Most presses with full revolution clutches have constant drag band or shoe type brakes, while most presses with part revolution clutches have disc or shoe brakes that are air-released when the clutch is engaged. Compression springs are used for applying proper braking torque. On many presses with full revolution clutches, this spring pressure is adjustable by means of a knurled knob. Supervision should make sure that all brakes are kept in proper adjustment to assure quick stopping.

Under certain circumstances, OSHA now requires monitoring of the brake system after each stroke of presses with part revolution clutches to detect any deterioration.

Inherent Hazards

In addition to mechanical power transmission hazards covered by OSHA Section 1910.219, there are possible hazards from broken or falling parts. Breakage of shafts may cause motor pulleys, flywheels, or gears to fall, and the loosening or breaking of mounting bolts may result in the falling of motors, protective covers, or other stationary parts. Paragraph (b) (1) of OSHA Section 1910.217 and paragraph 3.2.3 of B11.1-1971 require that such parts or assemblies be designed, secured, or covered to minimize these hazards, as well as the release of mechanical energy from such things as broken springs. Possible

pinch points between the slide and components such as feeding mechanisms and point of operation guards should be avoided or covered.

Point of operation hazards are an entirely different problem and do not come under construction requirements. Safeguarding the point of operation is covered by part (c) of OSHA Section 1910.217 and section 5 of B11.1. When two-hand control or two-hand trip is used for safeguarding, the control system must comply with both the construction requirements and the safeguarding requirements of the standard.

Full Revolution Clutch Presses

1. Single Stroke Capability. Present standards require that all presses with a full revolution clutch incorporate a single-stroke mechanism to prevent an unintended second stroke if the foot pedal or other stroking control means is not released before the completion of a stroke. Many older presses did not have a single stroke mechanism because early versions of the B11.1 code required it only when certain devices not directly connected to the slide, such as two-hand trip or some types of gates, were used for safeguarding.

The most effective type of single stroke mechanism is built into the clutch, but single stroke capability can also be provided by separate mechanical attachments or by the antirepeat feature of an electrical or pneumatic tripping system.

Full revolution clutch presses can be operated in the continuous mode by disabling the single stroke mechanism in various ways. It is expected that the next revision of B11.1 will not require a single stroke mechanism on presses designed specifically for and used only in the continuous mode. Any machine used in a single stroke operation, however, must have single stroke capability and be operated in the single stroke mode for that operation. If the single stroke mechanism is dependent upon spring action, the spring(s) must be of the compression type, operating on a rod or guided within a hole or tube, and designed to prevent interleaving in case of breakage.

2. Foot Pedals. When a mechanical

foot pedal is used on a full revolution clutch press, the pedal must be covered or otherwise protected to prevent unintended operation by falling or moving objects such as tools, trucks, and crane hooks or by accidental stepping onto the pedal. Since many older presses did not have a pedal cover, it may be necessary to add one to shroud the top and sides of each pedal. If an electrical or pneumatic foot control is used, it should also have the top and sides of the pedal covered.

3. Two-Hand Trip. If two-hand trip of any type is installed, the system must have each button protected by guard rings or other means against unintentional operation; have the buttons mounted so that use of both hands is required; require concurrent actuation of both buttons; and incorporate an antirepeat feature to limit the slide to a single stroke if either or both buttons are held in the actuated position. To initiate another stroke, both buttons must first be released.

If two-hand trip is used on a multiple operator press, each operator must have a separate set of controls.

If a two-hand trip is used for safeguarding the point of operation, each button must be located at a safe distance from the dies so that the operator cannot reach into the point of operation prior to the closure.

Part Revolution Clutch Presses

1. Stroking Selector. The control for part revolution clutch presses must have a means for selecting OFF, INCH, and SINGLE STROKE modes of operation, as well as CONTINUOUS if the press is intended to operate in the continuous mode. Fixing of selection must be by a means capable of supervision by the employer. A key lock is generally used for this.

Since 1971 all press builders have been using a stroking selector switch arrangement of OFF, INCH, SINGLE STROKE, and CONTINUOUS (when supplied) as the switch is turned clockwise. While not mandatory, this arrangement is recommended in B11.1-1971 for standardization purposes.

There have been accidents caused by inadvertent turning of the stroking selector to the continuous position

when single stroke operation was wanted, or because an operator on a new shift did not know that the controls were set for continuous operation. When this happens, there is no holding time during die closure, and the press does not stop at the end of the stroke. To prevent such accidents, controls on presses with both single stroke and continuous functions must now be arranged so that (1) completion of the continuous circuit may be supervised, and (2) the initiation of continuous run must require a different prior action or decision by the operator in addition to turning the stroking selector before actuation of the operating means will result in continuous stroking. Three of the possible arrangements are outlined in explanatory paragraphs of the B11.1 Standard.

2. Single Stroke Two Hand Control. When a part revolution clutch press has two-hand control for single stroke, the system must: (a) have all the features, including antirepeat and two protected buttons requiring use of both hands, called for in a two-hand trip system; (b) have holding time requiring the concurrent pressure from both hands during the die-closing portion of the stroke—this is obtained by proper adjustment of the rotary limit switch so that any release of a run button prior to die closing will stop slide motion; (c) any control installed after August 30, 1971 must have interrupted-stroke protection, requiring release of all buttons before an interrupted stroke can be resumed. Regardless of installation date, however, the control must have interrupted-stroke protection if a hand is placed in the dies for loading or removing parts.

Because electrical controls utilizing a pair of run buttons for each operator are the most common type of clutch control on presses with part revolution clutches, the term "run buttons" is used to describe the operating controls, although it's possible for such controls to be pneumatic, fluidic, or mechanical. If so, equivalent features are required.

If two-hand control is used on a multiple operator press, each operator or helper exposed to point of operation hazards must have a separate set of run buttons. The clutch control sys-

for stopping slide motion, OSHA requires that all clutch/brake valves installed on new or old air-clutch presses after August 30, 1971 must be designed to prevent a significant increase in the normal stopping time in case of a failure, and inhibit further operation if such failure does occur. A self-checking double valve is commonly used to provide this protection. The requirement does not apply to machines intended only for continuous, automatic feeding applications.

If one or both hands are placed in the point of operation for inserting or removing work, however, the exception for valves installed prior to August 31, 1971 does not apply and all valves on single-stroke air clutch presses must be of the double, self-checking type regardless of when the press or the valve was installed.

If a press has a separate clutch and brake system requiring individual valves connected to a common manifold, both valves should be of the self-checking, double type. Failure of a brake valve is just as dangerous as a faulty clutch valve, and sometimes is even more apt to cause an accident.

All clutch/brake air valves should be of the poppet type to minimize the possibility of sticking due to dirt or poor lubrication. Slide type valves should never be used for clutch or brake service.

tems for such presses must provide for activating and deactivating the run buttons in each operating station in complete sets. Locking out individual buttons is not permitted. The bypassing of stations not needed for particular operations must be done by a means capable of supervision. Operating station plug and receptacle arrangements with supervised dummy plugs for bypassing, or lockable selector switches are used to meet this requirement. The control system for such presses must also be designed with so-called "dummy plug protection" to prevent actuation of the clutch if all operating stations are by-passed.

If two-hand control is used for safeguarding the point of operation, each button must be located at a safe distance from the dies so an operator cannot release a button and reach into the die area before the slide motion stops.

Where an operator places one or both hands in the point of operation when inserting or removing work, and a two-hand control, presence sensing, or a type B gate is used for safeguarding, there are additional control reliability requirements called for in paragraph (b) (13) of OSHA Section 1910.217.

Clutch Brake Air Valve

Because a single air valve can fail to properly shut off incoming air and quickly exhaust clutch and brake air

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