Appendix VI-B. Summary of Case Studies Demonstrating Effectiveness of Ergonomic Programs/ Interventions

Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Food Packing	20	Implemented full program on packing line, including job task analysis, employee involvement in identifying problems and solutions, worker training, and medical management. Job analysis resulted in 56 proposals for changes in equipment and work environment, half of which were implemented in six months.		In 1976, prior to implementing the program, there were 51 hand MSDs identified among 200 packing workers. Hand MSDs were eliminated by 1980, four years after program implementation. Other upper extremity illnesses declined by about 47% in this same time period.	Luopajarvi et al. (1982) (Ex. 26-1042); Luopajarvi et al. (Undated) (Ex. 26-1090)
Meatpacker	2011	Training efforts included awareness training of corporate and plant managers and technical training of safety and medical personnel. Ergonomic task forces were established at individual plants to identify problem jobs and implement exposure controls. Controls included use of anti-fatigue mats and manual handling assists such as conveyors and trucks. Job rotation and cross-training of rotated workers was also employed.	Not Reported	Cumulative trauma injuries reduced from four in one month to none reported during a 6-month period.	McCasland (1992) (Ex. 26-1043)
Meatpacker- pork deboning	2011	Introduction of automated system for deboning/skinning and a pneumatic lifter to automate hanging of large sausage casings onto processing racks.	Lost time due to injury dropped from 30% of total work hours to less than 2%.	CTDs have declined from 84 cases to 9 cases over a 6-year period	Murphy (1992) (Ex. 26-1103)
Meatpacker	2011	Implementation of an ergonomics program, including engineering controls, work hardening program, training, and medical management.	Not Reported	CTDs decreased from 47.8 per 100 workers (1987) to 17.2/100 workers (1990) and 17.7/100 workers (1991).	OSHA Site Visit Case Study No. 2 (26-1175)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Meat preparation	2011	Introduction of engineering controls: redesigned workstation by sloping the work surface toward the meatcutter; introduced rotary cutter and single hooks.	Not Reported	80% reduction in musculoskeletal injuries in the first year.	Oxenburgh (1994) (Ex. 26-1041), Case 45
Poultry processing	2015	Implementation of an ergonomics program, including redesign of processing lines, use of rubber-matted stools and platforms of varying heights to eliminate awkward reaches, worker training, and job reassignment for injured workers.	Not Reported	Decline in upper-extremity and neck/shoulder injuries from about 32 per month to 0.	Farr (1991) (Ex. 26-1044)
Poultry processing	2015	Introduction of workstation analysis and redesign, including altering heights of products, providing workstands, and installing tank tilters to reduce manual handling. Program also included worker training and development of an integrated medical management/surveillance-analysis system.	Not Reported	Carpal tunnel incidence rates decreased from 7.8 per 200,000 hours to between 2.4 and 3.7 per 200,000 hours. Back injury rates declined from 4.4 per 200,000 hours to 3.0 per 200,000 hours.	Stuart-Buttle (1994) (Ex. 26-1045)
Poultry processing	2015	Introduction of engineering controls: tool/handle redesign; work practice controls; administrative controls.	Not Reported	Recordable injuries and illnesses decreased from 10-14/100 workers (1988-89) to 7/100 workers (1991).	OSHA Site Visit Case Study No. 1 (Ex. 26-1174)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Ice cream manufacture, various jobs	2024	Performed job hazard analysis, implemented several controls including use of non-skid elevating platforms for shorter workers; modified workspace layout to permit workers to move without being hindered; replaced sharp edges of ewuipment with sloping angles or padding; replace hygienic thin-filmed gloves with warm, flexible gloves; modified way employees performed lifting and carrying tasks.	In 1985, before implementing the program, there were 4 compensation claims and absenteeism equalled 10 % of the number of shifts worked. In 1897, there were no compensation claims and absenteeism was reduced to 4% of shifts worked.		Elie (OH&S Canada, Vol. 4, No. 7) (Ex. 26-1100)
Cattle feed processing operation	2048	Provided a forklift and a bobcat to eliminate manual lifting and relocated the feed mixer in order to install chutes and augers to permit mechanical loading of feed. Installed bulk storage containers so that additives could be gravity-fed to the mixer. Constructed a platform under the auger equal in height to the truck platform, which allowed feed bags to be filled without manual lifting. Program also included providing lifting and handling training to workers.	Not Reported	The company eliminated manual handling injuries.	Teleki (1995) (Ex. 26-1046)
Bakery	205	Engineering controls: workstation redesign, tool modifications; improved work practices; formation of labor-management CTD committee.	Absenteeism related to carpal tunnel syndrome decreased from 731 lost work days(1987) to 8 lost work days (Jan.-Aug., 1991).	Carpal tunnel cases decreased from 34 (1987) to 13 (1990).	Robinson (1993) (Ex. 26-1102)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Packaging sugar cubes	206	Cubes were packed tightly using a hand tool that required worker to exert considerable pressure on a sharp corner edge. Company changes marketing strategy that permitted cubes to be packed loosely, avoiding use of excessive hand force.	Considerable reduction in sickness absence and workers compensation claims.	Serious strain injuries to hands was "virtually" eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 41
Mattress manufacturer, material handling	2515	Introduction of hand trucks and lift systems to aid in manual handling. Job hazard analysis involving the employees in identification of problem areas and solutions to problems.	53.5% reduction in workers compensation reports in one year (1991).	Not Reported	Bedtimes (1992) (Ex. 26-1047)
Mattress manufacturer, material handling	2515	Job hazard analysis of all job functions to resolve ergonomic problems. Modified workstations, tools, and manufacturing procedures. Modified equipment to reduce need to lift items above shoulder height or below knee level.	Lost time reduced 1/4 to 1/3 in 3 years.	Not Reported	Bedtimes (1992) (Ex. 26-1047)
Mattress manufacturer, warehousing	2515	Added conveyor, increased fork truck use, reduced stacking heights, and revised handling procedures. Production process changed to eliminate material handling and loading onto truck.	Not Reported	Decreased injuries from 9 to 1 in one year.	Marcotte (undated) (Ex. 26-1048)
Office furniture manufacturing, various jobs	252	Introduction of a plant ergonomics program employing engineering controls, work practice controls, administrative controls, medical management, and education and training.	Restricted workdays decreased from 301/100 employees to 221/100 employees.	Decreased rate of MSDs from 21/100 employees (1989) to 19/100 employees (1991-1992).	Robinson (1993) (Ex. 26-1102)
Office furniture manufacturing, various jobs	252	Installed scissor lifts to aid in packaging file cabinets of different sizes. Small-assembly workstations were altered to eliminate twisting and bending during lifting.	Not Reported	Back injuries have been cut by 50 percent.	LaBar (1991) (Ex. 26-1078)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Pulp and paper mill workers	2611 & 2621	Conducted training sessions covering CTD issues and hazardous postures at the workplace. Job analysis included interviews of employees. Program included strengthening exercises and fitness initiatives. The following engineering controls were implemented: • reduced the number of wires per bale to reduce weight, • use of padded bolt cutter handles, • provided better lifting devices.	Not Reported	In a six-month follow-up to the interventions, the CTD rate had been diminished to zero and there were no wrist and elbow problems.	"Avenor's fitness a warm-up to ergonomics." CTD News (1996) (Ex. 26-1050)
Printing, glue machine operators	27	Installed partial mechanical aid for off loading of cartons.	Not Reported	No injuries reported in 2 yrs since changes.	Shinnick (1985) (Ex. 26-1049)
Book binding operator	278	Introduced industrial load leveler (a spring loaded table) for loading/unloading pockets, binders, stitchers, and off-line mailers.	Lost workdays fell from 413 to 112.	Not Reported	Ferris (1992) (Ex. 26-1051)
Organic chemical manufacture, manual handling	283	Analysis of injury data, observation of material handling tasks. Installed materials handling equipment, automated container-packaging and inspection equipment. Reduced weight of bags and drums. Worker training program.	Severe back injuries resulting in lost workdays were eliminated (1979-1989).	62% reduction in the incidence of total overexertion back injuries.	Ridyard (1990) (Ex. 26-1052)
Paint manufacturing, manual handling	2851	Installation of material handling equipment. Medical management of injuries.	From 1990-1993, lost time injury rate decreased by approximately 63%.	Total OSHA recordables reduced by 40% from 1990-1993.	Akzo Coatings, Inc. Louisville, KY. correspondence with OSHA (1994) (Ex. 26-1054)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Oil refinery, handling hoses and valves, manual handling	2911	Added platforms that make valve access easier, added extensions to valve stems to eliminate bending to turn valves, installed hoists over work tables to eliminate lifting and bending, purchased adjustable height carts, upgraded lighting, and conducted back injury training.	Not Reported	Injury rates dropped by 90%.	Bone (1993) (Ex. 26-1055)
Rubber hose manufacturing	3052	A new hand tool was designed (an air gun) that is counterbalanced to reduce the amount of weight supported. This tool also has better handles.	No lost time incidents from repetitive trauma since the new tool was introduced.	Not Reported	Oxenburgh (1994) (Ex. 26-1041), Case 7
Shoe/luggage manufacturing, various jobs	31	Instituted a comprehensive ergonomics program as part of a total quality management initiative. Program included elements of worker participation, medical management, job analysis and control of exposures to risk factors, and employee education and training. Exposure controls included installation of adjustable workstations; new jig fixtures to hold work pieces at proper angles; partial automation of processes; and use of anti-skid surfaces on tools, fixtures, and handles.	Reduced lost time upper extremity and back disorders by 79%.		Rooney and Morency (1992) (Ex. 26-1056)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Shoe manufacturer, various jobs	314	Several programs implemented that included exercise and conditioning, stretching, and ergonomics awareness training. Conducted special training on ergonomics for industrial engineers and maintenance workers. Continuous flow manufacturing including group working, cross training, and job rotation was instituted. Engineering controls implemented included:: • Purchase of new adjustable chairs; • Use of anti-fatigue mats for all employees whose jobs involved prolonged standing; • The cast iron base on heavy equipment was cut off and refitted with an adjustable base; • Electric or pneumatic foot pedals were used instead of non-adjustable mechanical ones; • Prepackaged shoe laces were purchased to eliminate hand-tying repetition; and • Sewing machines were tilted toward the worker to eliminate awkward posture.	Not Reported	Repetitive motion injuries in two problem areas were reduced from 70 percent to between 25 and 30 percent of the total OSHA recordable incidents in three years.	"Red Wing Shoes' early warning system." CTD News (1995) (Ex. 26-1057)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Shoe manufacture, pneumatic press operator	314	Workstation design improvements included use of adjustable chairs and footrests, providing armrests, changing angle of the presses, providing parts bins to reduce extreme wrist flexion, and redesigning shoe ornaments so prongs were angled for easier insertion and pressing.		No injuries reported for 2 years since changes were implemented.	Wick (1987) (Ex. 26-1058)
Footwear assembly and fabrication	3149	Extensive ergonomic training program.	Lost-time injuries dropped 67% in 2 years.	Total number of CTDs dropped by 62% in 2 years.	Holland (1991) (Ex. 26-1059)
Sewing and cutting operations	3199	Introduction of ergonomics program, including medical program to detect and treat CTDs early. Workplace modifications included use of adjustable workstations, footrests, and anti-fatigue mats; installing larger handles on hot irons to improve grip; installing proximity switches on presses; adjusting glue stations to prevent awkward upper-extremity postures; and automating some processes.	Not Reported	CTD incidence fell from 14.6% in 1990 to 11% in 1992	Nickasch (1994) (Ex. 26-1060)
Encapsulating automotive glass windows	3229	Ergonomics program and control measures, including installation of adjustable workstations, job rotation, and anti-fatigue matting; medical management program and an employee training program.	Incidence of lost-work-day injuries declined from 8.6% to 0.2% in 2 years. Rate of lost workdays declined from 1,615/100 workers (1990) to 0.9/100 workers (1992).	Not Reported	OSHA Site Visit Case Study No. 12 (Ex. 26-1182)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Packagers	3231	Workplace improvements included: Reduced all material handling to less than 50 pounds; Purchased different sizes of gloves, cuffs, and sleeves to reduce additional stress and energy expenditure; Designed a device that allows employees to roll the glass onto the line instead of lifting it; Raised the racks to knuckle height to avoid bending while lifting the windshields; and Altered the racks to allow workers to step into them and load them from back to front in order to eliminate stressful forward reaches.	Not Reported	Injury incidence rate dropped from 14 per 100 workers in 1987 to 3.3 in 1996. Reduced severity and frequency of injuries.	"PPG learned to overcome ergo innocence." CTD News (1996) (Ex. 26-1061)
Ceramic tile manufacturing, various jobs	3253	Implementation of an ergonomics program including engineering controls (workstation redesign), job rotation, changes in work practices, and an ergonomic training program for employees.	Lost-time injury rate for repetitive motion injuries decreased from 1.6 in 1988/1989 to 0 in 1993.	Not Reported	Stuart-Buttle (1994) (Ex. 26-1045)
Fiber-cement board manufacture, manual handling	3272	Install on-loader at from of conveyor to permit workers to load boards at their own pace. Automate process for separating boards and transferring them to the on-loader. Automate stacking of final product.	Eliminated lost-time MSDs in 2 years after improvements were made.	Not Reported	Oxenburgh (1994) (Ex. 26-1041), Case 11

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Metal castings, unpacking operation	33	Frequent, excessive reach was required to unpack 15- to 18-pound casting from crates. Creates were modified by adding drop gates at each end of the crates and installing a scissor lift to lift crates. In addition, changes were made in the way the castings were stacked in the crates to permit the workers' arms to remain close to the body while unpacking.	Not Reported	Eliminated back injuries associated with this operation.	Oxenburgh (1994) (Ex. 26-1041), Case 34
Palletizing operation	33	Scissor lift tables with turntable tops were installed alongside each packing station.	Not Reported	Five out of six back injuries were eliminated.	Benson, (1987) (Ex. 26-1062)
Aluminum manufacturer, materials handling	3350	Establishment of an ergonomics program, including of introduction lift tables, cranes, and mechanical assists in overhead lifting, rearrangement of work to allow use of cranes in lifting.	Not Reported	Reduced overexertion injuries of the back by 40% to 60%.	Mandelker (1993) (Ex. 26-1063)
De-burring and finishing cast metal parts	34	Parts were held still by hand during finishing operations. Work bench was replaced by a potter's wheel to hold the part and rotate it as necessary. Finishing tools were redesigned.	Not Reported	Upper-extremity disorders were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 43
Welding	34	Manual welding of a 5-meter weld required welder to work in a prolonged static posture. This process was replaced by a semi-automatic powder welding process, permitting welder to work from a standing position.	Not Reported	All knee, neck, and shoulder injuries from this operation have been eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 33
Materials handling, hardware manufacture	3411	Use of adjustable lift tables/ transporters completely eliminated manual lifting from the job.	Not Reported	Back injuries reduced by 90%.	"Put ergonomics to practical use." Material Handling Engineering (1988) (Ex. 26-1064)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Packager	3452	Packaging area was redesigned; raised the level at which boxes are lifted, installed semi-automatic sealing machines and adjustable chairs, and eliminated loading of pallets; training introduced.	Nearly a five-fold decrease in musculoskeletal injuries based on days lost. (equivalent to 5% of the department's total wage costs).	Not Reported	Oxenburgh (1994) (Ex. 26-1041), Case 10
Manufacturing automotive cables	3496	Introduction of ergonomics program utilizing engineering controls, work practice training, and medical management.	Lost workday cases decreased from 48 (1991) to 27 (1993). Number of lost workdays decreased from 1,287 days (1991) to 275 days (1993).	Decreased illnesses from 47 (1991) to 17 (1993)	OSHA Site Visit Case Study No. 11 (Ex. 26-1181)
Steel furniture manufacturing, various jobs	3499	Employee involvement in identifying hazards and developing interventions. Engineering approaches included the following: • An enclosed shotblaster machine has been used to automate polishing of the steel. • An automatic washing system has been provided. • Lighting placement and brightness have been improved to reduce the awkward posture required to inspect and brush the products. • Many of the jigs were improved to be adjustable. • And other engineering controls.	Lost days from carpal tunnel syndrome, back strain and other CTDs dropped to zero in 1996, down from 176 lost workdays in 1991.	Not Reported	"Charleston Forge welds homemade approach." CTD News (1996) (Ex. 26-1065)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Farm equipment manufacture, assembly and materials handling	3523	Initiated an eight-hour engineer ergonomics training program. Appointed ergonomics coordinators in all U.S. and Canadian factories, foundries and distribution centers chosen from the industrial engineering and safety departments. Conducted training through attending professional courses and conferences, memberships in professional organizations, subscriptions to ergonomics publications and tracking the latest ergonomics research. Conducted ergonomic review of new office furniture purchases. Conducted VDT ergonomics awareness training for video display operators. Engineering Controls included: • Limiting manual lifting to 40 pounds or less; • Redesigning the assembling operations so that assemblers worked in an upright position; • Altered hand tools for better fit; and • Installed hoists and lift tables.	83 percent reduction of back injuries that resulted in lost time.	Not Reported	"An ergo process that runs like a Deere." CTD News (1995) (Ex. 26-1101)
Welding, vehicle manufacture	3531	Ergonomic training program implemented, seat height adjustments installed, and work station height adjusted.	Not Reported	Back injury rate went down by 27%.	"Caterpilar, Inc." Welding Journal (1992) (Ex. 26-1066)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Chain saw assembly	3546	Introduction of new tools and modified production methods, and employee training.	The sick-leave rate decreased from 17.0 to 13.7 on an average annual basis.	Not Reported	Parenmark et al. (1993) (Ex. 26-1067)
Computer manufacturer	3571	The company engaged in several training and education initiatives, including: • Mandated ergonomics training classes for high risk groups; • Created and distributed a 16-page ergonomics brochure; and • Created an "ERGO Hotline" to schedule ergonomics evaluations, report problems, and seek information; Exposure control approaches included: • Limiting manual lifting to 40 pounds or less; educated the employees via a brief program on the basic ergonomics fundamentals; • Purchased new office sit-stand workstations; • Adjusted the workstation surface height to accommodate each worker; and • Attached a wider, adjustable keyboard and mouse platform to the standard desk.	Not Reported	• 41 percent drop in reportable upper limb disorders from 1994 to 1995 which addressed about 70 percent of the company's upper-limb reportable injuries. • Further 50 percent decrease in reportable CTD cases from 1995 to 1996. • Reportable cases of CTDs decreased to 25 through November of 1996 compared to 70 cases in 1994.	"Silicon Graphics melds high- and low-tech." CTD News (1997) (Ex. 26-1068)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Computer mainframe assembly	3571	Training had been provided for proper lifting techniques, general safety and use of special tools. Extensive office workstation ergonomics training was provided. Engineering controls included: • Providing new workbenches to accommodate workers' shorter reaches; • Adding roller-ball conveyor belts and lifting devices were added to raise the units onto the conveyor belt.; • Replacing pneumatic drivers with lighter electric units which had much less vibration and weighed about one pound; • Installing lift platforms that would raise the cabinets and 3 feet off the floor; • Providing seated and standing workstations so one employee could build the entire cabinet instead of working on an assembly line in order to reduce the static fatigue; and • Modifying scissor lifts to rise up to 4 feet off the floor.	There are no lost days due to CTDs in the office workplace.	CTD related injuries were eliminated in production.	"AT&T uses cost-conscious program to fight CTDs." CTD News (1995) (Ex. 26-1069)
Copying machine control system assembly	3579	Assembly of the systems was performed on a workbench and required frequent lifting and turning of the part. The bench was replaced by an adjustable stand designed to take the weight of the part being assembled.	Not Reported	MSD rate declined by 50% in the first year. In the second year, the MSD rate declined to one-third.	Oxenburgh (1994) (Ex. 26-1041), Case 37

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Hand tool operation, tele-communications manufacturing	36	Safety and health committee implemented program that included creation of task force, worker training, improvements in workstation design and tooling, and medical management of workers on restricted duty.		Plant-wide incidence of repetitive trauma disorders was 2.2 cases per 200,000 work hours, reduced to 0.53 cases per 200,000 workhours in 1 year after program implementation.	McKenzie et al. (1985) (Ex. 26-1070)
Electronics manufacture	36	Controls: workstation redesign and job rotation.	Not Reported	CTDs reduced by 46% in one year.	Robinson (1993) (Ex. 26-1102)
Electrical equipment manufacture, press operator	36	Automated handling and grinding of resistance elements. Eliminated possibility for hazardous exposures.	Not Reported	Eliminated MSDs	Oxenburgh (1994) (Ex. 26-1041), Case 16
Press operator, small electronic parts manufacture	36	Press operation caused excessive wrist flexion and palm compression. The press was modified by adding switches that either eliminated hand contact or only involved contact with parts of the hand that do not have nerves close to the skin surface.	Not Reported	29% reduction in musculoskeletal injury incidence.	Oxenburgh (1994) (Ex. 26-1041), Case 42
Lamp manufacturing, materials handling	3641	Added a vacuum hoist, reduced equipment height, reduced box size and weight, and introduced a back awareness program for employees.	Not Reported	Eliminated back and upper extremity disorders in the last four years.	Carreau and Bessett (1991) (Ex. 26-1071)
Telephone systems assembly	3661	Implemented an ergonomics program for the assembly line. Elements included an employee awareness program, disorder treatment protocols, job task analyses, job redesign, and cost savings analysis.	Lost-time repetitive strain injuries dropped from 20 to 4 over 1.5 years.		Darcangelo (1989) (Ex. 26-1072)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Tele-communications equipment assembly	3661	Introduced a training program, job hazard analysis, and an engineering program to abate ergonomic hazards. Medical management of injured employees on restricted jobs.		Rate of repetitive trauma disorders dropped from 1.1 per 100,000 hours to 0.26 per 100,000 hours in 1 year.	Pope (1987) (Ex. 26-1073)
Tele-communications equipment assembly	3661	Workstation redesign (adjustable tables, illumination), ergonomically designed chairs, and tool redesign.	Musculoskeletal injury sick leave in 1978=5.0, in 1982=2.9.	Not Reported	Westgaard and Aaras (1984) (Ex. 26-1026)
Electronics assembly	367	Job rotation, new assembly line procedures, and ergonomic line balancing.	Not Reported	No new cases of cumulative trauma were reported.	Townes and Imrhan (1991) (Ex. 26-1074)
Electronics manufacturing, various jobs	3674	Redesigned workstations; introduced powered-screwdrivers; job rotation.	Not Reported	Reduced injuries (not quantified).	Burri and Helander (undated) (Ex. 26-1075)
Vehicle seat assembly	371	Ergonomics training was provided. Engineering controls included: • Redesigning seat covers in order to decrease the number of fasteners by more than 50 percent; • Provided a compression tool to clamp the foam padding to the seat; • Installed adjustable workstations; • Provide electric torque guns. In addition, a program of job rotation was introduced.		Tendinitis cases fell by 93% and carpal tunnel cases fell by 96 percent in the year following program implementation.	"Problem-solving by committee at General Seating." CTD News (1995) (Ex. 26-1076)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
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Unpacking auto parts	371	A plywood sheet end board had to be removed to unpack crates, requiring excessive force and awkward postures. Plywood sheets were modified to reduce their weight and permit them to slide more easily in the grooves.	Not Reported	Back and shoulder injuries associated with this operation were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 38
Motor vehicle assembly, various jobs	371	Introduction of an ergonomics program, including engineering controls, work practice controls, job rotation/job enlargement, medical management, education, and training. Controls implemented included counterbalanced tools, lift tables, and workstation redesign to prevent awkward postures and excessive reaches.	Lost-time workday rate decreased 65%, and the lost-time case rate decreased 48%.	Over a 3 year period, the injury and illness rate decreased 11% and the severity rate decreased 39%.	OSHA Site Visit Case Study No. 10 (Ex. 26-1180)
Truck manufacturing, various jobs	3711	Introduction of company ergonomics program in 1990. Engineering controls: substituted machine riveting for manual riveting, introduced raised work heights, and installed lifting devices. Introduction of job rotation for 85% of the workforce.	• Lost-time injuries fell from 80 to 28 in 2 years. • Lost workdays fell from 1,402 to 193.	CTD cases fell from 105 to 54 in 2 years.	Mandelker (1993) (Ex. 26-1063)
Auto assembly	3711	Introduced variable height car conveyer belt, articulating arms to move large parts, like dashboards, into place. Also redesigned tools.	Not Reported	50% decline in ergonomic related injuries in the first year. 35% decline in second and third years.	LaBar (1992) (Ex. 26-1053)
Auto assembly line worker	3711	28 projects were redesigned to change specific jobs, making them ergonomically less troublesome.	Reduced from 3,134 lost days per year to 1,355 lost days per year after project completion.	Not Reported	Brandon (1992)
Auto body assembly, fixing side mouldings to body	3711	Replaced pneumatic nut runner with a lighter model. Used a stepped ramp that allowed workers to select an appropriate position relative to the work piece.	Not Reported	Upper-body MSDs were eliminated.	Oxenburgh (1994)(Ex. 26-1041), Case 50

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Spot welding onto auto frame	3711	Fixed a large-diameter circular handle to the welding frame, which allowed the frame to be moved into any position while keeping the wrist in a straight posture.	Not Reported	Wrist injuries were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 51
Spray painting auto bodies	3711	Lengthened spray gun trigger to increase gun's grip diameter and allow the trigger to be operated with three fingers.	Not Reported	Cases of hand tendinitis were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 52
Auto instrument panel assembly, manual handling	3714	Installed a hoist system to remove panels from conveyor and transport them to shipping containers.	Lost-time back injuries associated with this operation were eliminated.	Not reported	Oxenburgh (1994) (Ex. 26-1041), Case 40
Pneumatic screw feeder operation, auto instrument panel assembly	3714	Installed a counter-balanced articulated arm to reduce the weight of the tool.	Not Reported	Upper-body MSDs were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 46
Computer operator	3714	The company instituted a biannual training program to emphasize good lifting and pushing techniques as well as good posture. Also instituted a stretching exercise program and encouraged the CAD operators to take frequent short breaks. Engineering controls included: • Purchased 27 back cushions, 71 lumbar supports in three different sizes, 24 keyboard/mouse rests, and 12 document holders in the past five years; • Provided adjustable chairs; and • Provided foot rests for shorter workers.	Saved 20,000 hours lost time per year since eliminating CTD-related complaints.	Not Reported	"Communication drives process at Siemens." CTD News, (1997) (Ex. 26-1077)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Manufacturing of electronic components, various jobs	3714	Introduction of an in-plant ergonomics program, engineering controls including hand tool and workstation redesign, and lift devices. Job rotation and other administrative controls, work practice controls, medical management, and training also implemented.	Decrease of 50% from 116 lost-time days/100 workers (1990) to 58/100 workers (1991) for MSDS. Additional 50% decrease in 1992 to 29 lost-time days/100 workers.	The incidence rate of ergonomic disorders decreased by 67% from 37/100 workers (1990) to 12/100 workers (1992).	OSHA Site Visit Case Study No. 8 (Ex. 26-1178)
Automotive engine assembly	3714	A hoist was replaced by a conveyer belt set at waist height and part of the assembly process was automated.	70 days lost time and over 1,000 days on restricted duty were reduced to no lost days and no personnel on restricted duties.	Not Reported	Oxenburgh (1994) (Ex. 26-1041), Case 2
Small parts assembly machine operation	3714	Jammed machine required operator to climb a bar ladder while carrying a heavy load. A correctly designed ladder and catwalk were installed along with a chute to dispose of damaged parts without the need for carrying them.	Not Reported.	Foot and ankle MSDs associated with the operation were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 47
Automotive air conditioner manufacture, material handling	3714	Installed overhead conveyor belt that moves the condenser cores through the various procedures, minimizing manual handling. Also installed box tilers to assist in packaging and scissor lift for stacking.	.Prior to program, plant averaged 50 lost-time injuries per year, many of those back injuries. After program implementation, 2 back injuries have been recorded over a 4-year period.		LaBar (1991) (Ex. 26-1078)
Auto instrument panel sub-assembly	3714	Spring clips were pushed into position using a hand tool that required excessive force to operate. New tool was designed to reduce force and awkward positioning of the hand and wrist.	Not Reported	Wrist and hand injuries were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 49

Appendix VI-B. Summary of Case Studies Demonstrating Effectiveness of Ergonomic Programs/ Interventions

Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Trimming mouldings with hand cutter	3714	Hand cutters were replaced with automated or air-powered cutters.	Not Reported	Hand and wrist injuries associated with this operation were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 54
Manufacture of jet aircraft engine parts, various jobs	372	Implementation of ergonomics program, including engineering control measures, work practice controls, medical management, education, and training. Controls implemented included redesigning workstations to provide employees with more room to perform tasks, adding anti-fatigue mats and adjustable footrests, removed or padded tables and shelves to reduce contact stress, and installed vibration-absorbing pads onto grinding wheels.	Not Reported	Decrease in carpal tunnel syndrome cases from 26 in 1988, 11 of which required surgery, to 1 case in 1992 which did not require surgery.	OSHA Site Visit Case Study No. 9 (Ex. 26-1179)
Shipbuilder	3731	Initiated training classes covering the nature of CTDs, anthropometry, work physiology, back and wrist anatomy and proper work techniques, In-depth training course covered tool selection, work habits, alternating trigger fingers and hands Workers participated in evaluating and developing interventions for the welding department, and selecting pistol grip and in-line based tools so as to keep the wrists in a neutral posture. Installed scaffolding at the right height and distance from the work, and used ladders or installed scaffolding to higher positions for the work above shoulder height.	Decreased to only 6 lost-time ergonomics wrist injuries through November 1996, since training completed in June 1995. Eliminated lost time back injuries since July 1995.	Eliminated wrist injury in the welding department until March 1996. Reduced ergonomics case rates about 30 percent during 1996.	Training a 'limbsaver' at Newport News." CTD News (1997) (Ex. 26-1079)

Appendix VI-B. Summary of Case Studies Demonstrating Effectiveness of Ergonomic Programs/ Interventions

Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Motorcycle manufacturing, flywheel milling operations	3751	Introduction of lighter flywheel castings and an overhead lift; introduction of a customized deburring machine eliminating vibration exposures; introduction of a customized 40-ton press eliminating the use of the brass hammer.	MSDs involving lost or restricted workdays dropped from 27.6 per 100 workers in 1989 to 12.5 per 100 workers in 1993. The severity rate of MSDs dropped from 610 lost or restricted workdays per 100 workers in 1989 to 190 days in 1993.	Not Reported	McGlothlin and Baron (1991) (Ex. 26-1080)
Assembly of pressure-sensing instruments	3823	Forceful turning actions were required to fit an O-ring in place. Cordless screwdrivers were used with a custom attachment to bring wrists into stronger position and allow hand to employ a power grip.	Not Reported	Wrist and arm MSDs were eliminated.	Oxenburgh (1994) (Ex. 26-1041), Case 44
Medical needle manufacture, inspection station	384	Used task forces to identify jobs involving worker exposures to risk factors. Identified problems on quality control line and implemented design changes to the workstations.	.	Achieved 75% reduction in upper extremity MSD cases	Benden (1994) (Ex. 26-1081)
Manufacture of suction canisters used in surgical procedures	3841	Introduction of an ergonomics program utilizing a medical management program, employee training program, job rotation, and engineering controls. Controls implemented include replacing old wooden supply stations with ergonomically designed stations, and automating various processes.	Not Reported	Decrease in the ergonomic injury rate from 5.2/100 workers (1989) to 2.8/100 workers (1993).	OSHA Site Visit No. 16 (Ex. 26-1183)

Appendix VI-B. Summary of Case Studies Demonstrating Effectiveness of Ergonomic Programs/ Interventions

Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Manual handling of bulk paper	386	Two operators manually lifted large wads of paper from a trolley. Manual lifting was eliminated by installing a scissor lift. In addition, the trolley's runners were replaced by roller bearings that enabled the paper to be loaded onto the scissor lift without manual lifting.	Not Reported	There were 18 back injuries in one year prior to implementing changes. There have been no back injuries in the 3 years since mdifications were made.	Oxenburgh (1994) (Ex. 26-1041), Case 36
Manufacturing board games, inspection and packing	3944	Job analysis and problem solving involving employees to redesign packing workstations. Design changes included raising the height of conveyors, slowing conveyor speed (no effect on throughput), placing roller conveyors on an incline to facilitate carton removal, and changes in work procedures.		Eliminated all cumulative trauma injuries associated with job.	Cook and Marcotte (1990) (Ex. 26-1082)
Railroad repairmen	40	Introduced storage of tools and materials off the ground between knee and shoulder height; devised winches to lift and handle heavy equipment; and redesigned work tables, dollies, and carts to more easily handle train car parts.	Lost-work days reduced to zero for back injuries.	Low-back injuries reduced to zero.	McMahan (1991) (Ex. 26-1083)
VDT operator, package delivery service	42	Introduced sit-stand workstations that permit workers to adjust workstation to meet specific needs.		Reduced MSD cases by half in 12 months.	Nerhood and Thompson (1994) (Ex. 26-1084)
Freight truck terminal operations	4213	Established ergonomics program in esponse to rising number of back injuries. Program elements include analysis of injury records to identify hazardous operations, extensive use of lifting and carrying devices, providing extra personnel to handle heavy or awkward freight, employee training, and medical management of injured workers.	There were 7 lost-time injuries in 1989, followed by 4 in 1990 and 5 in 1991.	Total number of MSD cases decline from 13 in 1989 to 7 in 1990.	OSHA Site Visit No. 5 (Ex. 26-1177)

Appendix VI-B. Summary of Case Studies Demonstrating Effectiveness of Ergonomic Programs/ Interventions

Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
VDT operation, tele-communications establishment	481	Retrospective study of the impacts of an ergonomics program on 500 VDT operators. Program included job task analyses, workstation redesign, and worker education and training.	.	Number of upper extremity disorders over the 6 months prior to implementation of the program was 52; this was reduced to 29 for the 6 months following intervention	Tadano (1990)
Materials handling, electrical utility	4911	Redesigned equipment: • Weight of the water coolers reduced from 10 lbs to 5 lbs. • Rotating platform for transformers. Step and grab handles added to trucks. • New shovel handle and new pry bars. • Position of the kegs on trucks was lowered to minimize twisting of the back.	Lost time injuries reduced to 0.42 per 100 employees in 1989.	Injuries due to getting in and out of trucks reduced from 9 to 0 in year following redesign. No injuries from lifting the water kegs since the changes.	"Foiling field injuries with ergonomics." Electrical World (1990) (Ex. 26-1085)
Data entry operator, gas and electric utility	4932	• Engineering controls: workstation design. • Administrative controls implemented.	Lost time due to work-related injuries decreased from 1,008 hours/month to 584 hours one year later.	Not Reported	Couch (1990) (Ex. 26-1086)
Sewing machine operator	5137	Installed padded, swivel chairs with adjustable backs and improved materials handling methods. Also instituted an exercise program.	Not Reported	Incidence rate of tendinitis decreased from 12% to less than 1% in some plants.	Hammond-Smith (1990) (Ex. 26-1087)

Appendix VI-B. Summary of Case Studies Demonstrating Effectiveness of Ergonomic Programs/ Interventions

Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Material handling, grocery distribution center	514	Implemented comprehensive program that included hazard identification and job hazard analysis, medical management and reassignment of injured employees, worker training, and implementation of engineering and work practice controls. Controls included making minor modifications to some forklift equipment, replacing other equipment, and providing ergonomically designed workstations for data entry personnel.	Number of MSD workers compensation claims decline from 14 in 1989 to 8 in 1991.	Not Reported	OSHA Site Visit No. 4 (Ex. 26-1176)
Restaurant worker	5812	Reduced the amount of food served by the workers, and heavy porcelain crockery was replaced with plastic.	Not Reported	Reported injuries decreased 40%.	Oxenbrugh (1994) (Ex. 26-1041), Case 17
Pricer- clothing store	5932	Staples were reduced to one per tag and job rotation was introduced so that no one person stapled for more than 45 minutes at a time.	Not Reported	In 1994-1995, 23% of pricers had CTDs; 2 had bilateral carpal tunnel releases and were unable to return to work. In 1996-1997, 10% of pricers were affected, but all have returned to their jobs without surgery or impairment.	"ARC takes thrifty approach to ergonomics." CTD News (1998) (Ex. 26-1089)
Data entry	6021	Adjusted workstations and lighting.	Not Reported	Reduced neck tension syndrome from 54% to 16%.	Luopajarvi et al. (Undated) (Ex. 26-1090)

Appendix VI-B. Summary of Case Studies Demonstrating Effectiveness of Ergonomic Programs/ Interventions

Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Nursing assistants, nursing home	805	Implemented program to determine patient lifting tasks that were the most stressful; evaluate alternative devices for acceptability among assistants; train assistants in use of devices; and modifying shower rooms and patient care techniques to facilitate patient handling. Used walking belts and mechanical hoists for lifting aids.	Decrease of 634 lost workdays/100 FTEs before intervention to 317 lost workdays/100 FTEs post intervention.	Incidence for back injuries decreased from 83 to 47 per 200,000 work-hours.	Garg and Owen (undated) (Ex. 26-1093)
Nursing aides, nursing home	805	Committee of employees determined the types of mechanical devices that were needed, installed in 1993. Implemented employee training and modified duty programs.	Decrease in lost work days 38 in 1991 to 4 in 1994 (as of Nov), is largely attributed to the implementation of a no lifting greater than 50 pounds policy.	Not Reported	Comments to OSHA from Kennebec, (undated) (Ex. 26-1094)
Nurse, hospital	8062	Professional lifting team of 2 performs 95% of all patient lifts; nurses freed to do more nursing activities.	Not Reported	Back injuries reduced 94% first year after teams were implemented	Charney et al (1991) (Ex. 26-1091)
Nursing and laundry workers, hospital	8062	Worker education and training were provided. Employees were encouraged to take breaks. A regular maintenance program for equipment was initiated. New hand tools and lifting equipment were provided. Handles were installed onto tool carts. X-Ray cassettes were reorganized to avoid repetitive bending and back problems.	Lost-time hours in nursing ward fell 83 percent in 4 years. Lost-time hours among laundry workers fell 83 percent in 2 years.	Back injury rates in nursing wards fell 39 percent in 4 years. Back injury rates among laundry workers fell 71 percent in 2 years.	"Giving health-care workers a helping, mechanical hand." CTD News (1995) (Ex. 26-1092)

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Job Title or Activity	SIC Code	Ergonomic Solutions	Reported Reduction in Injury Rates		Sources
			Lost Workday MSDs	Total MSDs	
Nursing, hospital	8062	Ergonomic assessment of 14-room surgical suite, implemented changes in procedures for moving patients, maneuvering carts and equipement, using gall bladder boards, walking on wet floors, and accessing power outlets. Workers are periodically retrained in procedures to maintain awareness.	Not Reported	Back injury rates reduced by 25% in 18 months since program was implemented.	Garb and Dockery (1995) (Ex. 26-1095)
Prescription filling using a syringe, hospital	8062	A manual assist for syringe actuation was developed to reduce the thumb and pinch grasp forces required while using a standard syringe. The system, about the size of a hot dog bun, accommodates standard syringe sizes from 10cc to 60cc.	Not Reported	Upper extremity CTD cases were reduced from six to one.	"Case study 60: Hospital pharmacy liquid IV prescription filling using a syringe." ErgoWeb Inc., 1998 (Ex. 26-1096)
Hospital workers	8062	Patient Air Lift Systems introduced.	Not Reported	Reduced injuries at second hospital by 94%.	Brigham (1994) (Ex. 26-1097)
Nursing, hospital	8062	Redesigned work process: Mechanical lifting equipment, slide boards, and patient transfer belts.	Lost-time injuries reduced to 49 (down 35%), with 426 lost days (a 57% decrease),and 1,851 restricted days (a 54% decrease).	In 1994 total back injuries decreased to 85 (a 43% reduction)	Hospital Employee Health (1995) (Ex. 26-1098)
Government employees	91	Introduction of program of ergonomic improvements, education, training, and physical fitness activities.	Not Reported	1-year prevalence of back pain fell from 65 to 53 percent.	Shi (1993) (Ex. 26-1099)