BREAKOUT SESSION 4–2
PIPE TRADES AND SPECIALTY

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Everett [1997] described three plumbing and piping construction activities that consume 10% or more of the total work for the trade in southwestern Michigan. These activities were: *install pipe hangers, install piping systems,* and *install fixtures*. In the pipe trades breakout session, three installation activities and three tasks related to piping systems installation were added (Table P-1). The three activities added were: *install equipment, install deck inserts (i.e., site prep),* and *plan reading and detailing*. One additional task, *site cleanup,* could also be considered a required task for most other activities related to the pipe, electrical, and sheet metal trades. Time constraints prevented a full discussion of the additions.

After a discussion, a majority of pipe trades breakout session participants suggested modifying the risk scores assigned to several tasks (Table P-2).

Tasks

Drill Holes and Screw or Shoot Fasteners Into Ceiling

Non-residential piping systems are usually placed near the ceiling and supported by hangers. Hanging systems are often fastened directly to the building structure (e.g., concrete or metal ceiling), and installed by using a rotary hammer drill or a power-actuated tool (PAT). A rotary hammer drill is used to drill a mounting hole in concrete for the fasteners, and a PAT shoots a fastener (e.g., pin or bolt) into concrete or metal. A hammer, hand wrench or a screw gun is used to set or tighten the threaded connection for the hanging system.

The potential WMSD risk factors reported by meeting participants for *drill holes and screw* or *shoot fasteners into ceiling* were related to operating power tools overhead, such as the rotary hammer, PAT, and manual tools to tighten fittings. The body regions identified to be at greatest risk were the back and upper extremities, due to: force (physical exertion and tool rotation and impact), sustained non-neutral postures, vibration, and repetition. Conditions or circumstances that can increase the WMSD risks were: working overhead, tool torque and recoil, drilling into reinforced concrete, and the job characteristics (e.g., number and size of holes, frequency, and duration of drilling).

Currently available interventions reported to have been used by some contractors and trades people to address WMSD risk factors for *drill holes and screw/shoot fasteners into celing* are shown in Table P-3. Participants believed that tool users could benefit from improved tool design, including lower vibration levels, and that interventions were needed to support tools while they were being used overhead (e.g., drill stand).

Table P-1. Pipe trades activities and tasks [1]

Activity [2]	Basic Tasks [3]
Install pipe hangers	Formulate work sequence
	Carry materials to work location
	Measure and layout
	Drill holes
	Place hanger/fitting
	Screw/shoot into wall/ceiling
	Inspect work
Install domestic water pipes, sanitary sewers, gas pipes, etc.	Formulate work sequence
	Carry materials to work location
	Measure lengths of pipe
	Cut pipe
	Check for burrs
	Remove burrs, grind ends
	Move pipe to correct location
	Weld, solder, braze, screw, bolt
	Inspect work
	Position pipe [4]
	Test piping [4]
	Site clean-up [4]
Install fixtures	Formulate work sequence
	Carry materials to work location
	Measure and layout
	Drill holes
	Position fixture
	Attach fixture to wall/floor
	Inspect work
Install equipment [4]	
Install deck inserts (i.e., site prep) [4]	
Plan reading and detailing [4]	

[1] Unless otherwise described, activities and basic tasks are taken from Everett [1997]
[2] Activities are specified units of work that are completed on a construction site
[3] Tasks are the "fundamental building blocks of construction field work, each representing one in a series of steps which comprise an activity"
[4] Not included in Everett and added by stakeholders participating in the breakout session

Table P-2. Average work-related musculoskeletal disorder risk for pipe trade tasks [1]

Average Risk	Tasks
High	Place hanger/fitting
	Drill holes
	Screw/shoot into wall/ceiling
	Remove burrs, grind ends
	Join pipe [2]
	Lift and carry materials to work location[3]
Moderate	Attach fixture to wall/floor[4]
	Position fixture[4]
	Cut pipe
None-Low	Measure and layout
	Measure lengths of pipe
	Inspect work
	Formulate work sequence

1 Everett [1997]

2 Participants substituted join pipe for weld, solder, braze, screw, and bolt, and the task risk was upgraded to High-risk from the Moderate-risk category

3 Participants renamed Everett's task lift and carry to carry materials to work location, and the task risk was upgraded from the Moderate-risk to High-risk category. This basic task includes unloading equipment and material from trucks to intermediate staging areas, and to point of use areas.

4 Participants downgraded risk from the High-risk to Moderate-risk category

Table P-3. Drill holes and screw or shoot fasteners into ceiling (currently available interventions)

Problem	Intervention	Comment
Operate tool (general)	Improved ergonomic design features	Develop intervention
	Tool does the work, not tradesperson	Disseminate intervention
	Remote actuating device (i.e., foot pedal)	Evaluate intervention Prevent trigger finger
Tool torque/vibration	Clutch-driven tool to control torque	Disseminate intervention
	Second grip to control torque	
	Tool designed to dampen vibration	Develop and/or disseminate intervention
	Vibration dampening-glove[1]	
Tool recoil	Tool designed to dampen recoil	Develop and/or disseminate intervention
Drill bit sharpness	Tool and bit maintenance program	Disseminate intervention
Drilling above shoulders	Engineered or designed hanger system (i.e., embedded concrete systems, etc. into structure)	Develop and disseminate intervention
	Drill stand (i.e., inverted drill press, mining roof bolt drill, etc.)	Develop intervention
	Drill bit extension—purchase or fabricate	Disseminate intervention
	Suspension and balance system for tool	
	Belt holder for tool (i.e., flag holder)	Develop intervention
	Neck pillow	Evaluate intervention
	Mechanical lift preferred to ladders; ladder platform better than ladder	Disseminate intervention
Standing on concrete	Anti-fatigue mats or shoe inserts	Disseminate intervention Work site use may require culture change
General	Job rotation when possible	Disseminate intervention
	Micro-breaks	Disseminate intervention
	Physical conditioning (i.e., stretch and flex)[2]	Disseminate intervention
	Assignments made according to physical capabilities	
	Alert to current information on tool development (i.e., speak with tool reps)	Disseminate intervention
	Pre-job hazard analysis and management communication regarding safety	Disseminate intervention

[1] Only gloves that have passed the ISO 10819 test procedures should be considered anti-vibration gloves. In addition, anti-vibration gloves should be matched to the dynamic properties of the vibrating tool and should not increase or introduce new risk factors for WMSDs, such as requiring higher grip forces [Mansfield 2005]

[2] The effectiveness of stretching exercises in preventing injuries from work has not been proven. For more infomation on this topic, see Hess et al., 2003

Place and Install Hangers for Mechanical Hanging Systems for Small Bore Pipe (≤ 6-Inch Diameter)

Mechanical systems are supported by hangers attached to the building structure, with or without modifying the structure. Drilling or shooting studs into concrete or metal ceilings modifies the structure, while attaching a beam clamp to a steel girder does not modify the structure. In either case, the trade person must assemble the hanging system and fasten it to the building structure using power and/or hand tools.

Potential WMSD risk factors reported by meeting participants for place and install hangers for mechanical hanging systems were related to fabricating and assembling hanging systems, including power tools and hand tools held above shoulder level. The body regions identified by participants to be at greatest risk were the upper extremities and shoulders, due to: forceful exertions, tool reaction forces (rotational and impact), sustained non-neutral postures, repetition, and hand-arm vibration. Conditions or circumstances reported by participants to increase the WMSD risks were: working overhead, working on the floor (e.g., bent forward or kneeling), tool torque and recoil (e.g., PAT), and the job characteristics (e.g., number of hangers, fasteners, etc.).

Currently available interventions reported to have been used by some contractors and tradespeople to address WMSD risk factors for *place and install hangers for mechanical hanging systems for small bore pipe* are shown in Table P-4. Participants believed that hanging systems could be better engineered into the building structure (e.g., embedded concrete inserts).

Lift and Carry Materials and Equipment

Materials and tools used to install piping systems must be unloaded, stored until needed, and transported to the location where they will be used. Many factors determine whether the material handling will be done manually or mechanically, and how often something must be handled.

Potential WMSD risk factors reported by meeting participants for this task were related to lifting, carrying, and pushing-pulling the following items throughout the construction site: materials, equipment, and tools. The body regions identified by participants to be at greatest risk were the back and shoulders, due to: force (weight of objects), awkward postures (bending and twisting), and contact stress (materials pressing against the body). Conditions or circumstances reported by participants to increase or decrease the actual WMSD risks included the following: inside vs. outside work; the condition of the floors, walkways, and ground surfaces (e.g., mud, rebar mat, uneven surfaces); the location and way materials are stored (e.g., on the ground, racks, or pallets); hand-to-object coupling (e.g., use of one or two hands, and full-hand or partial-hand grip); work on multiple floors or levels; weather conditions; the availability and maintenance of material handling equipment; and, the degree of site planning and communication among contractors (e.g., repeated handling of materials, or materials stored in the way of other trades).

Currently available interventions reported to have been used by some contractors and tradespeople to address WMSD risk factors for *lift and carry materials and equipment* are shown in Table P-5.

Table P-4. Place and install hangers for mechanical systems (currently available interventions)

Problem	Intervention	Comment
Place or install hangers	Hangers engineered into building structure (i.e., embedded concrete)	Disseminate intervention
	Lighter materials to reduce weight	
	Micro-breaks when doing hand-intensive tasks	
	Physical conditioning (i.e., stretch and flex)[1]	
Cut metal	Tool selection based on ergonomic design features (i.e., low vibration)	Develop and disseminate intervention
Screw nuts to thread	Split nuts for all threads	Disseminate intervention
	Open-end ratchet to thread hangers	Disseminate intervention
Use manual hand tools	Tool selection based on appropriate design features for activity	Disseminate intervention
	Micro-breaks for hand-intensive tasks	
Work overhead	Stable work platform (i.e., scissors or vertical lift)	Disseminate intervention
	Extension poles and remote triggering available from Hilti & other vendors	Disseminate intervention
Multi-employer site	Communication and planning of tasks with other contractors	Disseminate intervention

[1] The effectiveness of stretching exercises in preventing injuries from work has not been proven. For more information on this topic, see Hess et al., 2003.

Table P-5. Lift and carry materials and equipment (currently available interventions)

Problem	Intervention	Comment
Lift and carry heavy objects	Material handling equipment (i.e., pipe carriage with offset extended handle, pipe stand with casters, carts, grasshopper, pallet jack, fork truck, cranes, helicopters, etc.)	Problems are work surface and equipment availability. Should not need to go far to get equipment
	Lift/carry devices (i.e., double-hook or single circular slings, fabricated handles, suction and magnetic handles, handy hook, shoulder guard, etc.)	Evaluate and disseminate intervention Improve hand-object coupling and reduce contact stresses
	Roller conveyor systems	Locations where fork truck, etc. cannot operate
	Lift pipe and materials between floors with a cran	Eliminates manual materials handling (MMH) between floors
	Shoulder guard	Evaluate and disseminate intervention
	Best glove for optimal coupling (i.e., glove size, grippers, etc.)	Evaluate and disseminate intervention
	Attention to exposure limits (e.g., NIOSH lifting equation [1994], Dutch construction industry push/pull/carry limits)	Evaluate and disseminate intervention
	Weight of materials and objects by color coding other identification	Object profile influences limits (e.g., size, shape, etc.)
	Coordination and planning of work site activities, (i.e., off-load close to use location, just-in-time delivery)	Disseminate intervention Space limiting factor (i.e., zero lot line jobs). Unloading sometimes done in evening
	Training (i.e., stretch and flex programs)[1]	Evaluate and disseminate intervention
	Housekeeping (i.e., 5 "S" program)	Evaluate and disseminate intervention
Lift and position	Use ladder hoist roustabout (i.e., tripod stand on wheels)	
	Lift pipe held in a "v" fixture with an attached fittings box	
	Use hoisting equipment for mechanical advantag (chain falls, com-a-longs, forklifts, cranes, etc.)	Disseminate intervention
Storage	Off-ground storage for materials (i.e., pallets, cut-away bins), to eliminate severe forward bending	Disseminate intervention
	Vertical gang/tool box (i.e., cabinet style)	Disseminate intervention Reduce bending
	Bag and tag by use location (i.e., also system use global positioning system [GPS] to locate materials and equipment)	

[1] The effectiveness of stretching exercises in preventing injuries from work has not been proven. For more information on this topic, see Hess et al., 2003

PROCEEDINGS OF A MEETING TO EXPLORE THE USE OF ERGONOMICS INTERVENTIONS FOR THE MECHANICAL AND ELECTRICAL TRADES

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