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**Sheet Metal & HVAC**

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**Task:** **Weld, Braze and Solder Seams and Joints**

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**Hazard:** **Kneeling & Squatting**

**Problem:** Workers may kneel or squat while welding, brazing and soldering seams and joints which can put excessive pressure on the knee joint. Frequent kneeling or squatting can lead to musculoskeletal disorders of the knee.

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**Risk Description:** The squatting or kneeling position characterized by prolonged periods of time spent with the knee in a deep bend is a risk factor for knee pain. Working in kneeling or squatting posture while welding, brazing and soldering seams and joints can increase forces in the knee. The cumulative effects of kneeling or squatting may lead to knee injuries such as bursitis or osteoarthritis.

**Osteoarthritis of the Knee**

**Prepatellar Bursitis**

**Osteoarthritis of the Knee (OA)**

Osteoarthritis (also called OA or degenerative joint disease) is the deterioration of the cartilage of the knee leading to the narrowing of the joint space. Cartilage acts as a cushion in joints. If cartilage is destroyed there is direct bone on bone contact, which causes OA.

**Work-Related Risk Factors**

- Awkward knee postures
- Repetitive knee flexion (e.g. bending, kneeling, squatting, and climbing)
- Heavy lifting on a regular basis, especially from a squat position
- Work that combines both heavy lifting, and kneeling or squatting

Osteoarthritis can also be caused by injuries to the knee joint and obesity. There may be a genetic tendency to develop OA.



### Development and Progression

Frequently bending the knee while performing activities such as kneeling, squatting, climbing, and heavy manual material handling create pressure on structures in the knee (compressive forces). These compressive forces gradually wear down the cartilage, leaving no cushioning between the bones. With the loss of this protective cushioning, the synovial lining and bones thicken, which in turn causes a build up of fluid known as "water on the knee." Bone spurs develop in many cases.

### Common Symptoms

Individuals with OA often complain of stiffness and pain in the affected joint. Swelling and redness of the affected joint are also common. Until OA is severe, pain is often relieved with rest.

### Common Treatment

Exercise, weight loss, and bracing of the knee can be effective therapies for resolving pain due to OA. Nonsteroidal anti-inflammatory drugs (NSAIDs, e.g. ibuprofen or naproxen), acetaminophen and other medications are often helpful. Other treatments include rest, heat applications, and physical therapy. Injections of corticosteroids ("cortisone injections") may be beneficial in the short term. Injection of a synthetic lubrication fluid is sometimes used in severe OA.

Surgical treatment, including arthroscopy, osteotomy, and arthroplasty (joint replacement), are sometimes necessary to regain normal function in the knee joint

Alternative treatments such as acupuncture, magnetic pulse therapy, vitamin regimes, and topical pain relievers have also been shown effective for some in the resolution of symptoms of OA.

### **Prepatellar Bursitis**

The prepatellar bursa is a flat sac on the front of the kneecap (patella). Irritation of the bursa causes bursitis. Prepatellar bursitis, also called "housemaid's knee," is common among roofers, carpet layers, and other workers who kneel often. Repeated knee bending can also irritate other bursa in the knee.



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Work-Related Risk Factors

- Prolonged kneeling
- Prolonged and repeated squatting

Development and Progression

Bursas act to reduce friction between bony structures, or between bones and other soft tissue. Normal bursas are a flat sac somewhat like a zip-lock bag. When the bursa is irritated, fluid enters the bursa and causes it to expand. This, in turn, leads to swelling and pain of the knee.

Common Symptoms

Workers with prepatellar bursitis often notice rapid swelling on the front of kneecap. Pain occurs with activity, and the front of the kneecap may be tender and warm to the touch. The swelling leads to stiffness of the knee and pain with walking. Individuals may have a slight limp when first getting up from sitting.

Common Treatment

Initial treatment includes rest, ice, and compression of the knee with an elastic bandage. Application of heat and Nonsteroidal anti-inflammatory drugs (NSAIDs, e.g. ibuprofen or naproxen) are often helpful. The bursa may need to be drained (aspiration) by a physician. Physical therapy can help with stretching of muscles around the knee if these muscles are tight. Strengthening exercises are often needed in chronic knee bursitis. Correcting gait abnormalities, such as those caused by a difference in leg lengths, is also important.

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**Level of Risk:** Workloads or activities are of such a magnitude and character that a significant number of workers risk developing an MSD in the short or long term.

Frequent squatting may cause musculoskeletal disorders of the knee, including osteoarthritis (degenerative joint disease). Biomechanical studies have shown that forces in the knee are high when the knee is



deeply bent, to an angle beyond 120 degrees. Forces during deep squatting are approximately three to five times the body weight. These forces can lead to cartilage loss and eventually to osteoarthritis.

Several epidemiologic studies have examined the link between squatting/kneeling and musculoskeletal disorders of the knee. In a national survey of working adults (aged 33-41) the incidence of knee injuries was linked to the hazardous job activity of kneeling or crouching. Workers who kneel or squat frequently often experience higher rates of knee disorders. Other studies have shown that squatting increases the risk of moderate to severe knee osteoarthritis and knee pain.

Construction workers are at high risk for OA if they spend much of the day kneeling, squatting or using a knee-kicker. Frequent kneeling or squatting doubles the likelihood of OA of the knees and there is evidence that after 2 hours a day the risk is significant.

**Assessment** To assess exposure to kneeling and squatting postures, determine  
**Info:** how many hours per day the worker spends with their knee(s) bent deeply >120°. Also, visit [Thomas Bernard's](#) website for a host of practical ergonomic tools.

To assess the exposure to kneeling and squatting, it is necessary to observe a worker forming, pouring, laying or applying refractory materials. Look for:

- time spent with the knee deeply bent (more than 120°)
- time spent directly on the knees

The risk of injury increases with more time spent in a kneeling or squatting posture and a greater degree of bending.

Also visit [Thomas Bernard's website](#) for a host of practical ergonomics tools.

#### References

Bernard, B. P. (April 1, 2007). Analysis tools for ergonomists. Retrieved June 11, 2007, from <http://personal.health.usf.edu/tbernard/ergotools/index.html>