HANFORD MISSION SUPPORT CONTRACT

# Hot Tapping

**MSC-PRAC-30500**

**Revision 0**

**Effective Date: January 15, 2010**

**Topic: Safety and Health**

# Hot Tapping



**PURPOSE**

This practice identifies a key aspect of the Safety and Health (S&H) Program and establishes the requirements for welding a hot tap connection onto a pipe or vessel fabricated from ferritic and austenitic steel.

**SCOPE**

This practice includes the following major sections:

- General Requirements
- Metallurgy
- Hot Tap Machines
- Preparation
- Welding Procedure

The requirements of this practice are consistent with the requirements published in the Hanford Mission Support Contract (MSC) Safety and Health, virtual manual.

**APPLICATION**

This practice applies to Mission Support Alliance (MSA) Construction personnel, except the following activities:

- Hot taps on gas or liquefied petroleum transmission
- Pipelines
- Service taps on gas mains
- Piping or vessel material fabricated from aluminum, copper, cast iron, or plastic.

**GENERAL REQUIREMENTS**

Records generated during the performance of this activity are to be included in the Construction Work Package and will be managed in accordance with MSC-PRAC-30374, *Construction Work Package* and MSC-PRAC-30376, *Construction Document Control*.

An engineered design with a drawing approval cycle is developed for the proposed hot tap. The design includes:

- Metallurgical analysis, including wall thickness, determination by ultrasonic test (UT)
- In-process controls and inspections to ensure conformance to design
- Approval of subcontractor/lower -tier contractor procedures
- Review by MSA project/site management and client

A detailed Task-Specific Job Safety Analysis (K-3 JSA), form A-6004-279, or written procedure is prepared for each hot tap (refer to practice MSC-PRAC-30462, *Prejob Safety Planning*. This JSA/procedure meets

the requirements of Safe Hot Tapping Practices in the Petroleum & Petrochemical Industries, latest edition, and those publications referenced therein.

Chapter 3 of MSC-5173, *MSC Radiological Control Manual*, is used when planning radiological work in conjunction with JSA/AJHA development.

Isolation barriers, safety zones, etc., are established as appropriate and in accordance with practice MSC-PRAC-30479, *Signs Signals, and Barriers* around the component or system to which a hot tap connection is being made.

The *Hot Tap Permit*, form A-6004-322, is prepared for each hot tap.

Hot tapping is performed by qualified professionals who specialize in performing such work on a frequent basis.

Client representatives are included from initial designs through hot tap completion.

Hot work on piping and other operating equipment is not done when pressures are less than atmospheric or greater than 4820 kPa (700 pounds per square inch [psi]) and temperatures are less than 21° C (70 °F) or greater than 315° C (600 °F). Exceptions may be permitted with additional engineering and/or consultation with appropriate industrial specialists.

The pipe, tank, or vessel walls are at least the minimum thickness for the design temperature and pressure, plus 2.4 millimeters (3/32 inch), but in no case less than 4.8 millimeters (3/16 inch). The thickness is confirmed by ultrasonic testing.

The metallurgy of the pipe, tank, or vessel is fully determined prior to welding.

Hot taps are not performed upstream of rotating equipment without filters or traps to retain cuttings.

The chance of blow-through is greatest on welds running longitudinal to the piping. Therefore, on full encirclement fittings, the only welds made directly to the pipe are the end circumferential welds.

Minimum velocity (flow) of the fluid/gas is specified in the job plan for each hot tap.

Piping with high flow rates or refrigerated liquids tends to result in the weld quenching too rapidly, which may contribute to weld cracking problems. Bolt-on tees suitable for the service are used where weld cracking or stress relief is a problem.

**METALLURGY**

Vessels or lines to be hot tapped are inspected for adequate wall thickness and absence of imperfections to minimize the risk of burn-through. Qualified welders adhere to controlled welding techniques/procedures to prevent overheating.

Hot taps are made in lamination-free areas with adequate metal thickness. A thorough inspection of each connection area verifies that the metal thickness is adequate for the pressure and temperature involved and there is no lamination or other metal imperfections.

**Burn-Through Prevention**

To minimize the possibility of burn-through, the first weld pass to the equipment is made using applicable regulatory agency standard guidelines. Subsequent passes are made with a 3 millimeter or 1/8-inch electrode diameter, or less if the metal thickness does not exceed 12.7 millimeters (1/2 inch).

**NOTE:** *In many situations, low hydrogen rods may be preferable to reduce the possibility of burn-through. For a wall thickness greater than 12.7 millimeters where burn-through is not a primary concern, larger diameter electrodes may be used.*

**Metal Thickness**

A minimum base metal thickness of 4.8 millimeters is generally required for hot tapping. Exceptions to the thickness may be permitted when allowed in engineering specifications.

**NOTE:** *Welding on thin material could result in overheating and burn-through. If practical, temporarily reduce the pressure and/or temperature within the equipment to provide an additional safety factor while welding takes place.*

**Metal Temperature** If the metal temperature is less than 10° C (50 °F), heating the weld area before welding is considered. Generally, welding is not performed on piping or equipment when the atmospheric temperature is less than –45° C (–50 °F), unless special consideration is given to the base metal characteristics, electrodes, and a method of metal preheating. Hot tap machines are checked for suitability of use at low temperatures. Under all circumstances, hot tapping is limited to the pressure/temperature rating of the machine.

**Stress Relief** Some equipment is unsuitable for hot tapping because the metallurgy or thickness of metal requires stress relieving, which normally cannot be done while the equipment is pressurized. Special treatment is required for high tensile strength alloy steels; special-welding electrodes are used. Hot tap fitting and weld rod metallurgy are compatible with the metallurgy of equipment to be tapped.

**Chemistry of Line or Vessel Content** The oxygen level within the equipment is controlled to prevent the formation of a vapor/air mixture within flammable or explosive ranges. In addition, contents of the line or vessel being hot tapped do not contain the following:

- Hydrogen, where the equipment has operated above the Nelson curve limits, because of the possibility of hydrogen molecules attaching to the metal (reference API RP 941. American Petroleum Institute [API]).
- Vapor/air or vapor/oxygen mixtures within flammable or explosive ranges.
- Acids, chlorides, peroxides, or other chemicals likely to decompose or become hazardous from the heat of welding.
- Caustic or amine if the concentration and temperature are such that the fabrication specifications call for stress relieving.
- Certain unsaturated hydrocarbons that may experience exothermic decomposition reaction (ethylene, for example) if the metal temperature resulting from hot tapping could initiate such a reaction at the maximum expected pressure. Such reactions could have the potential for causing localized hot spots on pipe walls that could lead to failure.

**HOT TAP MACHINES**

Hot tapping machines are certified (with documented proof of certification) for maximum working pressure and temperature rating. The machine is able to positively retain and remove the blank or coupon.

A hot tap machine is considered suitable if the pressure and temperature of the medium inside the line or vessel falls within the working limits of the hot tap machine. The seals and materials of the hot tap machine are compatible with the fluids in the line or vessel and the material of the drill or cutter is suitable for effective penetration of the metal of the pipe or vessel.

Before hot tapping is attempted, the machine, cutter, and pilot bit are carefully inspected to ensure that they are in satisfactory condition and capable of being left in service, if necessary, in the event of mechanical problems or hot tap valve leakage.

**PREPARATION**

Mounting, assembling, and operation of the hot tapping machine are performed by personnel trained for this purpose. Selection of the proper fitting and reinforcement for use in making the hot tap connection is based on the proper codes (refer to API). The overall fitting and valve assembly length does not exceed the machine boring bar maximum travel. Weldolets, weld-ends, split tees, saddles, nozzles, branch-o-lets, or plain meters may be used depending on the reinforcement needed. If hot tap diameter is greater than 50 percent of the run pipe diameter, full encirclement pads or split tees are used.

The geometry of the fitting attachment is determined before welding. Careful measurements are made to ensure that:

- The tapping machine has sufficient overhead clearance for its full travel.
- The valve is sufficiently deep so that the pilot bit clears the valve seat when retracted.
- The tapping machine cutting rod is of sufficient length to cut entirely through the pipe, vessel, or tank wall.
- For piping, the cutter does not cut the opposite wall of the pipe.
- The cutter head is of sufficient depth to cut heavy wall vessels and pipes.
- The proper angularity (if kept between the nozzle and the wall) and

all elements (seat rings, bolt circles, etc.) are concentric with each other to prevent jamming or obstruction of the cutter in its travel.

If the hot tap is not vertical, a nipple with an attached small gate valve is welded to the bottom of the tapping valve for blowing or washing cuttings out of the seating area.

**WELDING PROCEDURE**

Welding is performed using welding procedures qualified to the applicable code(s) and specification(s), and welders are qualified to the welding procedures, code(s), and specification(s).

On storage tanks, the liquid level is at least 915 millimeters (3 feet) above any welding. Floating roof tanks have roofs floating. Welding is not permitted on the deck of a floating roof except under very carefully controlled conditions. Emergency exit plans are in place before starting work on such roofs. Additionally, extreme caution through careful planning is maintained when welding in the following locations of floating roof tanks:

- Inside the pontoon
- Between the deck and liquid surface near the tank roof gauge float compartment
- Near the roof seal vent
- Near the floating roof lift leg vent
- Between the primary and secondary seals

Nozzles are beveled 45°–50° from the outside. The entire weld on carbon steel nozzles is made with American Welding Society (AWS) E7018 electrodes or equivalent.

The nozzle pad is air- or nitrogen-tested and soaped for leaks.

Hot taps are performed on flowing lines with exceptions requiring attention as follows:

- Static lines are full and properly vented if run is less than 6.1 meters (20 feet).
- Welding is not done on empty or partially full lines without proper purging and testing.

- The degree of hazard on lines carrying gas under pressure will determine if a hot tap can be performed safely.

Avoid hot taps within 460 millimeters (18 inches) of a pipe anchor, expansion joint, expansion loop, flanged connection, or threaded connection.

The hot tap fitting is full-fusion welded to the equipment to be tapped (normally) at a right angle. The fitting is contoured to the shape with a nozzle bevel and 3 millimeters gap to permit full penetration weld. Longitudinal welds on encirclement tees, saddles, and sleeves do not tie onto pipe.

Before the tap is made, a test on the branch is carried out with the valve in position to test the valve gaskets and packing, and to check the attachment weld. Hydrostatic testing is done at temperatures below 95°C (203 F). Pneumatic testing, using air or nitrogen, is done at temperatures above 95° C; soaping for leaks is used for pneumatic test.

**FORMS**

Form A-6004-279, *Task-Specific Job Safety Analysis (K-3 JSA)*
Form A-6004-322, *Hot Tap Permit*

**RECORDS IDENTIFICATION**

**Records Capture Table**

| Name of Document | Submittal Responsibility | Retention Responsibility |
|---|---|---|
| Form A-6004-279 , *Task-Specific Job Safety Analysis (K-3 JSA)* | Construction Supervisor/Superintendent | Project Document Control |
| Form A-6004-322, *Hot Tap Permit* | Construction Supervisor/Superintendent | Project Document Control |

**REFERENCES**

American Petroleum Institute (API)
API RP 2201, *Safe Hot Tapping Practices in the Petroleum and Petrochemical Industries*
API RP 941, *Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants*

MSC-PRAC-30374, *Construction Work Package*
MSC-PRAC-30376, *Construction Document Control*
MSC-PRAC-30462, *Prejob Safety Planning*
MSC-PRAC-30479, *Signs Signals, and Barriers*