(2) 4 mm ($^{5}/_{32}$ in.) for forged pressure retention tee-type connections

(c) Welding of hot tap fittings should not be performed on thinner walls unless justified by mock-up, engineering analysis, or prior successful experience with similar welding procedures. The inside surface temperature of the vessel or pipe wall should be below 980°C (1,800°F) during welding to prevent burn-through but this temperature can be excessive for some products (see paras. 216-2.3 and 216-2.4).

(d) The area to be welded for hot tap fittings on the vessel, pipe, or tank should be examined using UT scanning to ensure adequate thickness and soundness of the plate or pipe wall throughout the area to be welded.

(e) Welding of hot tap fittings shall not be performed if there is not sufficient thickness to contain the internal pressure, and prevent burn-through in the vessel or pipe wall during welding. If there is insufficient thickness

(1) the pressure should be reduced to a safe level to allow in-service welding

(2) an alternative piping design should be considered, or

(3) the use of a mechanical connection may be considered

216-3.12 Maximum Allowable Internal Pressure for Welding of Hot Tap Fittings

(a) The maximum allowable internal pressure that is permitted during welding of the hot tap fittings shall be calculated by the equation in the applicable construction code or by an engineering analysis.

(b) The available thickness, the average metal temperature, and the allowable tensile stress during welding may be established as follows:

(1) Calculate the wall thickness, t, available to contain internal pressure as follows:

$$t = \text{measured wall thickness} - 2.4\ \text{mm}\ (^{3}/_{32}\ \text{in.})$$

as a margin to prevent burn-through.

(2) Adjust the outside diameter to be used in the calculation as follows:

$$D = \text{pipe or vessel O.D.} - 4.8\ \text{mm}\ (^{3}/_{16}\ \text{in.})$$

(3) Let T_1 = service temperature and D_1 = inside diameter.

(4) Assume the temperature in the depth of penetration plus recrystallization zone is T_2 and equal to 750°C (1,380°F).

(5) Calculate the average temperature in the remaining metal available for internal pressure containment, T_m

$$T_m = T_2 + (T_1 - T_2)\left[\frac{1}{\ln\left(\frac{D}{D_1}\right)} - \frac{D}{D - D_1}\right]$$

where

D = outside diameter
D_1 = inside diameter
T_1 = operating temperature during hot tap
T_2 = 750°C (1,380°F), the assumed temperature in the depth of penetration plus recrystallization zone

(6) Establish the yield strength of the component wall at the calculated average metal temperature, T_m.

(-a) The yield strength at temperature T_m may be obtained from ASME Boiler and Pressure Vessel Code, Section II, Part D, Table Y-1 for temperatures up to and including 1,000°F (538°C). For some materials, the yield strength at higher temperatures can be found in published literature (see para. 216-7.3, reference [4]).

(-b) The allowable design stress, S, for the component wall shall not exceed two-thirds of the yield strength at temperature T_m, the hot tap temperature in the vessel or pipe wall.

216-3.13 Maximum Permissible External Pressure

(a) The maximum allowable external test pressure (without internal pressure) during the hot tap hydrostatic testing on the pressure vessel, storage tank, or pipe wall shall be determined by use of the appropriate formula from the applicable construction code or post-construction code or standard, using the measured wall thickness and the maximum expected operating temperature of the hot-tapped equipment.

(b) The assessment of the allowable external pressure to avoid buckling or plastic collapse may be calculated by use of the procedures and equation in the original construction code or by one of the following methods:

(1) In hot taps employing full encirclement sleeves or split tees, the maximum allowable external pressure may be determined by the requirements in ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, UG-28 through UG-30, using the centerline length between the circumferential welds between the split tee and the run pipe as length L, and the measured thickness of the pressure component, to calculate the ratio D/t (where D is the outside diameter of the pressure component subjected to external pressure and t is the measured thickness).

(2) For hot taps on cylinders employing set-on-type nozzles with or without reinforcing pads, the maximum allowable external pressure to prevent buckling of the pipe or vessel shell wall may be determined by the following calculation: