

Engineering Procedure

SAEP-311

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Installation of Hot Tapped and Stopple Connections

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Saudi Aramco DeskTop Standards

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1 Scope

- 1.1 This Saudi Aramco Engineering Procedure (SAEP) provides the installation and hot tapping procedures for welded connections to pipe, pressure vessels and tanks while in service.
- 1.2 Also included are procedures for plugging pipelines through hot tapped connections (stoppling).
- 1.3 The SAEP assigns responsibilities for the work required and the safety precautions to be taken.
- 1.4 This SAEP is not intended to detail all aspects of the operations and does not include adequate information to enable it to be used as an instruction manual. The equipment manufacturer's instruction manuals and data sheets will also need to be referenced and utilized.

Commentary:

Hot tapping and stoppling are complex operations to be performed by trained technicians with the support of experienced engineers.

2 Conflicts and Deviations

- 2.1 Any conflicts between this standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Consulting Services Department of Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this standard in writing to the Company or Buyer Representative, who shall follow internal company procedure SAEP-302 and forward such requests to the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

3 References

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

SAEP-310 Pipeline Repair and Maintenance

Saudi Aramco Engineering Standards

SAES-A-004 General requirements for Pressure Testing

SAES-D-008 Repairs, Alterations, and Re-rating of Pressured Equipment

SAES-L-101 Regulated Vendor List for Pipes, Fittings and Gaskets

SAES-L-110 Limitations on Pipe Joints and Components

SAES-L-150 Pressure Testing of Plant Piping and Pipelines

SAES-W-010 Welding Requirements for Pressure Vessels

SAES-W-011 Welding Requirements for On-Plot Piping

SAES-W-012 Welding Requirements for Pipelines

Saudi Aramco Materials Specification

02-SAMSS-006 Hot Tap and Stopple Fittings

Saudi Aramco Standard Drawings

AB-036719 Reinforcement of Welded Branch Connections

AE-036175 Detail of Heavy Welding Boss for Threaded Connections to Vessels and Lines

AD-036643 Detail of Heavy Welding Boss for Socket Weld Connections

Saudi Aramco Forms and Data Sheets

Form SA 7235-ENG Hot Tap Data and Checklist

Form SA 7627-ENG Hot Tap/Stopple & Reinforcement Calculation Request

Saudi Aramco General Instructions

GI-0002.100 Work Permits

GI-0002.102 Safety Precautions for Pressure Testing

GI-1780.001 Atmosphere-Supplying Respirators

3.2 Industry Codes and Standards

American Petroleum Institute

API STD 598 Valve Inspections and Test

*API RP 2201 Procedures for Welding or Hot Tapping on
Equipment Containing Flammables*

American Society of Mechanical Engineers/Boiler and Pressure Vessel Code

ASME SEC VIII D1 Pressure Vessels

Pipelines Research Council International (PRCI)

*PR-185-617 Criteria for Hot-Tap Welding (catalogue #
L51548)*

*PR-185-816 Review of procedures for Welding unto
Pressurized Pipelines (catalogue # L51601)*

*NG-18 Report # 175 Proof Testing of the Pre-Hot-Tap Branch
Connection (catalogue # L51561e)*

Commentary:

Referencing to PRCI reports is intended for expanding knowledge and to locate sources of many of the technical basis for the requirements of this procedure. It is not intended to be a mandatory document.

4 Definitions

Hot Tap: Hot tapping is a technique, performed using specialized equipment for cutting a hole in a pipe, vessel or tank through a welded or bolted branch connection while they are under pressure.

Lock-o-Ring Flange and Plug: This is a special flange and plug assembly that enables the recovery of the hot tap valve while the pipeline is under pressure. The L-o-R plug has an o-ring seal on its circumference and can be lowered into the bore of the L-o-R flange, using a hot tap machine. The L-o-R flange has retractable segments that can be advanced into a groove in the circumference of the plug above the o-ring. These segments retain the plug in position so that the valve can be depressurized and removed and replaced with a blind flange or permanent valve.

Sandwich Valve: A special gate valve with a short face to face dimension used as a temporary valve for stoppling. They are also used for hot tapping when the connection will only be used temporarily or when the reach of the hot tap machine is insufficient to

complete a hot tap through a conventional valve. These valves cannot be operated unless the pressure is equalized across the gate.

Stopple: A stopple is an articulated pipe plugging device, normally inserted through a stopple split tee with a full line size hot tapped opening, while the line is pressurized. Saudi Aramco has stoppling equipment for pipe sizes from 1" to 56".

Stopple Split Tee: A stopple split tee is a specialized fitting with dimensional requirements to suit the stopple plugging head. A regular full sized split tee will not be acceptable for stoppling.

5 Responsibilities

- 5.1 Full responsibility for the hot tap design is to be assumed by the engineering group that prepares the calculations, design drawings and installation procedures. The detailed hot tap installation design package shall be approved in writing by the Operations Superintendent, or higher. The responsibilities and involvement of relevant organizations are detailed below.
- 5.2 Prior to detailing and commencing the hot tap operation, the appropriateness of this operation shall be evaluated utilizing logical diagram Figure -2 of APRI Recommended Practice 2201.
- 5.3 Initiating Organization
 - 5.3.1 The hot tapping operation shall be controlled by an initiating organization which will be either one of the following:
 - The Operations Engineering Organization when the work is being undertaken by the Operations Organization.
 - Project Management with the approval of the Area Operations Superintendent and Operations Engineering General Supervisor / Superintendent in the case of tying in new installations, constructed by Project Management to existing facilities.
 - 5.3.2 The initiating organization shall prepare a design package for each hot tap that will include fully dimensioned drawings, a materials list, Direct Charge Requisitions and welding procedures.
 - 5.3.3 The initiating organization shall appoint a Responsible Engineer to carryout the following duties and responsibilities:-
 - 5.3.3.1 Be responsible for the overall coordination of the hot tapping activities. This is to ensure that designers, construction and hot tap organizations, operations and/or

project management, engineering staff, and inspection staff cooperate closely during all phases of the hot tapping operations.

- 5.3.3.2 Initiate form 7627-ENG, "Hot Tap / Stopple and Reinforcement Calculation Request" and complete form 7235-ENG, "Hot Tap Data & Checklist" in accordance with sections 7.2 and 7.3 of this SAEP.
- 5.3.3.3 Make all necessary arrangements for the preparation of the new connection. (i.e., location, excavation, scaffolding, pipe inspection, surface preparation, etc.)
- 5.3.3.4 Arrange for a team, consisting of himself, Operations, the responsible inspector and a representative of the Hot Tap and Stoppling crew, to survey the general hot tap location in order to specify and mark the hot tap locations in detail.
- 5.3.3.5 Mark the exact hot tap locations, and mark the hot tap number (obtained from Form SA 7627-ENG) alongside each hot tap location.
- 5.3.3.6 Make available to the site a copy of this SAEP and the installation package during the entire installation process.
- 5.3.3.7 Revise existing Saudi Aramco drawings, P&IDs, or preparing new drawings, as may be required, as a result of the hot tap installation.

5.4 Hot Tap and Stopple Unit / Pipelines

The Hot Tap & Stopple Unit is responsible for the following:

- 5.4.1 The design package shall be approved by Hot Tap Group/Pipelines Department.
- 5.4.2 Review the Form 7235-ENG and ensure that the equipment required to perform the hot tap is available.
- 5.4.3 Perform the hot tapping and / or stoppling operation in the safest and in accordance with this procedure and an approved detailed procedure.
- 5.4.4 Any Direct Charge Requisitions prepared as part of the design package for hot tap tees, stopple split tees, or Lock-o-Ring flanges must be reviewed and approved by the Hot Tap and Stopple Unit prior to issuing for purchase.

5.5 Inspection Organization

The Inspection Unit of the Proponent Organization shall be responsible for the following:

- 5.5.1 Review and concur with the design package prior to the start of the installation.
- 5.5.2 Ensure that the connection is installed in accordance with the design package.
- 5.5.3 Inspect and determine the minimum pipe wall thickness at the tie-in weld areas by a continuous UT scan along the lines to be welded and record this on the applicable form in Appendix A.1 of this SAEP.
- 5.5.4 Review the welding procedure specification (WPS) and ensure that it has been approved by Consulting Services Department.
- 5.5.5 Approve the fit up of the branch connection/split tee to the pipe prior to welding.
- 5.5.6 Inspect the branch connection/split tee, before and during the installation, for compliance with the approved drawings and welding procedures.
- 5.5.7 Confirm that the hydrostatic test pressure for the branch connection is correct at the time of the test, as prescribed in Section 4 of Form SA 7627-ENG.
- 5.5.8 Verify that calibrated pressure gauges and relief valve are properly installed for hydrotesting.
- 5.5.9 Inform the Responsible Engineer if the seam weld or any other projection needs to be ground flush with the pipe surface to permit proper UT scanning or fit-up of the split tee or reinforcing sleeve.
- 5.5.10 Scan the weld zone and 50 mm (2 inches) each side of it.
- 5.5.11 Mark the inspected area permanently for future reference and identification.
- 5.5.12 Consult with the Responsible Engineer and the responsible Operations Engineering Organization If ultrasonic readings indicate a lamination or evidence of hydrogen induced cracking (HIC) damage in order to relocate the hot tap position. CSD and the proponent group shall be notified of this condition.

5.6 Construction or Maintenance Unit

The construction or maintenance units are responsible for ensuring that approved welding procedures and qualified welders are employed.

5.7 Consulting Services Department

5.7.1 Approve the welding procedure specification (WPS).

5.7.2 Approve the detailed design and installation procedure by Chairman of the Piping Standards Committee as stipulated in Paragraph 6.2.

5.7.3 Process the waivers.

5.8 Loss Prevention Department

The Loss Prevention office responsible for the area where the hot tap activities will commence shall be notified of all hot tap work and provided with procedures for review.

6 Limitations on Hot Tap & Stopple Applications

6.1 Welding and hot tapping shall not be allowed in the following cases.

6.1.1 The operating pressure of the pipeline or vessel exceeds the maximum operating pressure of any of the hot tap or stopple equipment while it is installed on the pipelines or vessel.

Commentary Note:

All hot tap and stopple equipment must be stamped with its maximum operating pressure.

6.1.2 The pipe or vessel contains flammable materials below atmospheric pressure.

6.1.3 The pipe or vessel contains a combustible mixture.

6.1.4 Hot tapping on cone or floating roofs of tanks in hydrocarbon service.

6.2 Welding and hot tapping shall not be performed in the following cases unless a detailed design and installation procedure has been approved by the Chairman of the Piping Standards Committee.

6.2.1 Hot taps on air lines or vessels with compressed air if there is any possibility of hydrocarbon contamination, unless the equipment being tapped is thoroughly cleaned or inerted prior to welding.

Commentary Note:

Most industrial compressed air systems will have hydrocarbon contamination from compressor lubricating oil and will therefore required being inert.

- 6.2.2 Any pressure vessel, heat exchanger, fired heater or boiler, manufactured in accordance with ASME Boiler and Pressure codes. This is dictated by SAES-D-008.
- 6.2.3 The pipe or vessel contains any of the following:
 - a) Liquid acids
 - b) Caustic
 - c) Elemental Sulfur
 - d) Oxygen
 - e) Chlorine
 - f) Ammonia
 - g) Potential toxic material that would be injurious to personnel by contact
- 6.2.4 The material to be welded may suffer metallurgical or physical deterioration from heating or requires post weld heat treatment.
- 6.2.5 The pipe or vessel has a corrosion or heat resistant lining such as metal lining or cladding.

This restriction does not include internally coated piping or vessels but the damage that will result to the coating by hot tapping should be considered by the Operating Department.
- 6.3 Welding and hot tapping shall not be performed in the following cases unless a detailed design and installation procedure has been approved by the Piping Standard Chairman with endorsement of the Proponent.
 - 6.3.1 Piping with internal coating
 - 6.3.2 The pipe or surface temperature is at or below zero degrees centigrade (0°C).
- 6.4 Hot taps shall not be made upstream of rotating machinery or in-line rotating instruments unless facilities exist to prevent chips and shavings from entering the equipment. Normal in-line suction screens are not considered adequate for this purpose.

When hot tapping 2-inch connections (e.g., Cosasco fitting) and smaller, the requirement for preventing chips and shavings from entering the equipment is at the discretion of the proponent.

- 6.5 The maximum operating pressure shall not exceed the rated design pressure of the hot tap or the stopple machines and components. Examples of such limits are:
- a) Pipelines plug equipment are designed to a pressure of 1000 PSIG.
 - b) The operating pressure during tapping exceeds 9930 kPa at 38°C (1440 psig at 100°F) or 4830 kPa at 370°C (700 psig at 700°F) for T.D. Williamson models 360, 660, or 1200 tapping machines.
 - c) The operating pressure during tapping exceeds 8270 kPa up to 93°C (1200 psig up to 200°F) for T.D. Williamson model 2400 tapping machine.

7 Safety Requirements

- 7.1 All work shall be in strict compliance with GI-0002.100, Work Permit System.
- 7.2 The Operations Superintendent will assure that both Operations and the Installation Organization have the proper safety and fire protection equipment on site and in workable condition prior to the start of the job and that all relevant personnel are notified of the scheduled hot work.
- 7.3 Precautions against H₂S and other hydrocarbon or hazardous releases.
- 7.3.1 If a potential exists for a Hydrogen Sulfide release (or other toxic gas) at a work site, all personnel involved shall be provided with an appropriate breathing apparatus. (Refer to GI-1780.001, "Atmosphere-Supplying Respirators").
- The standby person or fire watch, or other person certified as a gas tester, shall continuously monitor the work site for the presence of hazardous gases during the work activity using established gas testing procedures.
- 7.3.2 When on welding hydrocarbon lines, the fire watch personnel shall be clearly instructed that should a burn-thru occur, the fire jetting from the pipe **should not be extinguished**. This is particularly important if the hydrocarbon contains H₂S. If a burn-thru should occur, the Operations Superintendent should immediately be notified to advise further action.
- 7.3.3 The chamber of the hot tap machine and valve shall be purged with nitrogen and discharged to a safe location after cutting the coupon,

retracting the cutter and closing the tapping valve when any of the following exist:

- a) H₂S concentration is greater than 10 ppm.
- b) Low wind conditions exist and a gas or liquid hydrocarbon release may create a hazard in the area or activate plant gas alarms.
- c) The work is in a confined area.

- 7.4 Appropriate barricades and warning signs shall be posted around the worksite to minimize the number of personnel in the work area while performing the hot tapping operation.
- 7.5 Precautions against electric shock, due to induced voltage, shall be taken when installing hot tap connections on above ground pipelines near high voltage power lines.
- 7.6 Additional requirement SAEP-310, "Pipelines Repair and Maintenance" may be applicable, therefore it is recommended to refer to this document.

8 General Design Requirements

8.1 Design Package

8.1.1 The initiating organization shall prepare a design package for each hot tap that will include fully dimensioned drawings, a materials list, Direct Charge Requisitions and welding procedures.

8.1.2 The design package shall be approved by Hot Tap Group.

8.2 Hot tap connections shall be designed for the Maximum Allowable Operating Pressure for the tapped equipment being in accordance with the applicable ASME code.

8.3 The dimensions of the connection, the hot tap valve, and the clearances shall be within the limits specified for the hot tapping equipment to be used (Hot-Tap and Stopple Unit can provide this data).

8.4 The minimum bore of the valve shall be large enough to pass the cutter.

8.5 If lugs on the valve seats restrict the opening they shall be removed.

Commentary Note:

In case of stoppling always uses a sandwich valve which will have sufficient bore.

- 8.6 A tap equal to the nominal size of the header (such as required for stoppling of a pipeline) shall be made only when the accurate positioning of the cutter can be guaranteed.
- 8.7 In hot tap cases other than those for stoppling purposes, the cutter shall be at least one pipe size smaller than the pipe to be tapped.
- 8.8 If the hot tap is to be used for stoppling the pipe, the hot tap crew must take measurements to ensure that the pipe out of roundness meets the tolerances in the following table:

**Table 1 – Acceptable Header Diameter
Out of Roundness for Stopple Installation**

Header Size (Stopple Size)	Maximum Acceptable out of Roundness Tolerance
Up to 32"	0.125"
34" & Greater	0.4% of Header Diameter

- 8.9 Adequate support of the hot tap machine shall be provided to prevent overstressing of the pipe and/or fitting, particularly in cases where the hot tap sticker is not installed in a vertical position.
- 8.10 Storage Tanks
- 8.10.1 For atmospheric or low pressure hydrocarbon storage tanks, hot tap connections shall be located at least 1 m (39 inches) below the liquid level while welding or hot tapping is in progress.
- 8.10.2 If the tank or vessel is in service during the welding or hot tapping process, the operating organization must ensure that the liquid level above the level of the weld or cut shall not be less than 1 meter.
- 8.10.3 Connections on tanks shall meet the requirements SAES-D-108.

9 Limitations on Materials

- 9.1 Hot tap and stopple fittings shall be procured from an approved manufacturer per SAES-L-101.
- 9.2 Any Direct Charge Requisitions prepared as part of the design package for hot tap tees, stopple split tees, or Lock-o-Ring flanges must be reviewed and approved by the Hot Tap and Stopple Unit prior to issuing for purchase.

- 9.3 Hot tap and stopple fittings shall comply with Saudi Aramco Material Specification 02-SAMSS-006.
- 9.4 For hardenable or high strength steels and for piping where pipe or fitting wall thickness requires preheat, the Consulting Services Department shall be contacted for welding procedure approval.
- 9.5 Compact steel gate valves with extended body ends shall not be used for hot tap connections.

10 Limitations on Flow and Pressure

10.1 The Maximum flow velocities during hot tapping shall be as follows:

- a) Liquid & two-phase 4.50 m/sec (15ft/s) maximum
- b) Gas 9.10 m/sec (30ft/s) maximum

Commentary Notes:

- 1) *T.D. Williamson (a major supplier of hot tap equipment) has established the above maximum flow velocity in lines during the hot tapping operation. Higher velocities may cause spinning of the coupon on the pilot drill and subsequent loss of the coupon. If higher velocities cannot be avoided, the Hot Tap & Stopples Unit should be consulted as steps can be taken to ensure that the coupon does not become detached even at higher velocities.*
- 2) *Small diameter hot taps (i.e., 2 inch and less) are normally performed with a drill which does not cut a coupon, therefore no velocity restrictions apply.*

10.2 Establishing flow in the header is not mandatory during hot tapping for pipe 0.5 inches and higher. Refer to PRCI report PR-185-617 and PR-185-816 for details. Consult with CSD for cases with lower thickness to get approval by the Piping Specialist and the Welding Specialist.

Commentary Note:

When performing the coupon cutting operation for a stopple, flow in the pipeline to disperse the cuttings away from the stopple sealing area is advantageous but not essential.

11 Documentation

The appropriate forms shall be completed, distributed and documented as detailed in the section follows.

11.1 Form 7627-ENG, "Hot Tap/Stopples & Reinforcement Calculation"

- 11.1.1 The Responsible Engineer shall prepare a separate Form SA 7627-ENG for each hot tap operation.
- 11.1.2 Each Form SA 7627-ENG shall be completed in sequence and by the organization identified:

Form Section #	Person/Organization
1	Responsible Engineer
2	Operations Engineer
3	Responsible Insp. Unit
4	Operations or Project Engineer

(For calculating the max. pressure during welding, see paragraph 13.5.5 for calculating the max. connection test pressure, see paragraphs 13.5.1, 13.5.2, 13.5.3 or 13.5.4)

- 11.1.3 The Responsible Engineer shall forward the form, when Sections 1, 2, and 3 are complete, together with ultrasonic thickness measurements (Appendix A.1 of this SAEP), to the Project Engineer or responsible Operations Engineering Supervisor.
- 11.1.4 The Project Engineer or the responsible Operations Engineering Supervisor shall perform the required calculations in accordance with Section 13 of this procedure and shall complete Section 4 of Form SA 7627-ENG.
- 11.1.5 The responsible engineering shall determine and obtain the appropriate approvals on Form SA 7627-ENG.
- 11.1.6 Drawings and specifications prepared by the responsible engineering shall include the length, diameter, wall thickness, flange rating and material of the new connection plus the type and dimensions of the connection reinforcement, if required (Refer to Std. Dwg. AB-036719).
- 11.1.7 Welding Procedure Specifications shall be approved by the Consulting Services Department/Welding Unit.
- 11.1.8 After the responsible engineering group has obtained the appropriate approvals, a record copy shall be retained in a permanent central file, and the design package forwarded to the Responsible Engineer for construction.
- 11.1.9 Once approval is obtained, the Responsible engineer shall distribute copies of each Form SA 7627-ENG to the following personnel:

- 1) Operations Superintendent
- 2) Hot Tap and Stopple Unit
- 3) Operations Engineering Supervisor
- 4) Construction/Maintenance Installation Crew
- 5) Responsible Inspection Supervisor
- 7) Project Manager (if appropriate)

11.2 Form SA7235-ENG "Hot Tap Data and Checklist":

- 11.2.1 The Responsible Engineer shall prepare and forward Form SA 7235-ENG "Hot Tap Data & Check List" to the appropriate maintenance group performing the actual hot tap.
- 11.2.2 The data entered in this form must be obtained from a site inspection of the hot tap connection.
- 11.2.3 For hot taps to be made by Pipelines Maintenance Hot Tap and Stopple Unit, the SA 7235-ENG Form shall be sent to:

Hot Tap and Stopple Unit
Bldg. 3176, Old Abqaiq Rd., Dhahran

11.3 Other Drawing Revisions

The Responsible Engineer is responsible for revising and updating existing Saudi Aramco drawings, P&IDs and any other drawing affected as a result of the hot tap installation.

12 Installation & Welding of Hot Tap and Stopple Connections

- 12.1 The minimum remaining wall thickness at the weld connection area shall not be below minimum thickness, T_m , as specified on the Safety Instruction Sheet (SIS), and in all cases, no less than 5 mm (0.2 inch).

Commentary Note:

Welding of hot tap connections on pipe or vessels containing non-hazardous material such as water at less than 150 psig and below 65°C when the wall thickness is below 5 mm (0.2 inch) may be undertaken provided the possibility of burn-through is recognized and the consequences accepted by the construction agent and proponent (this condition still requires a waiver to be processed thru CSD).

- 12.2 Existing welds under hot tap fittings or reinforcing pads (or sleeves) shall be ground smooth as required to ensure acceptable fit up. This is particularly
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important for stopple fittings where the outlet flange must be accurately centered on the pipe and a projecting weld would prevent this. If possible, the hot tap location should be selected such that no welds are located under the area to be cut by the hot tap cutter.

- 12.3 If the hot tap is required for a stopple operation, the pipe roundness and alignment of the stopple fitting must be checked and approved by the Hot Tap & Stopple Unit.
- 12.4 For carbon steels with minimum specified yield stresses less than or equal to 60 ksi, pre-approved welding procedures may be used.
- 12.5 For carbon steels with minimum specified yield stresses greater than 60 ksi, the Consulting Services Department shall be contacted for welding procedure approval.
- 12.6 For hardenable or high strength steels and for piping where pipe or fitting wall thickness requires preheat per the applicable ASME code, the Consulting Services Department shall be contacted for welding procedure approval.
- 12.7 Welding on Pipelines Under Pressure
 - 12.7.1 The form SA 7627-ENG shall specify the maximum internal pressure in the pipeline. The pressure in the pipe during welding shall not exceed that calculated by the following formula:

$$P_{\max} = \frac{2S(t - 0.10)F}{OD} \quad (1)$$

Where:

- $P_{\max}$ = Maximum operating pressure of the pipeline during welding, psig
- S = Specified minimum yield strength of the pipe, psi
- t = Minimum measured wall thickness of the pipe at the weld area, inches.
- F = 0.72 (Design factor of the pipeline).
- OD = Outside diameter of the pipe, inches.

Commentary Notes:

1. *The minus 0.10 inch wall thickness takes into account the molten and heat affected portion of the base metal which does not contribute to pressure containment.*

2. *For in-plant piping designed to ASME B31.3, replace S and F in the formula with the allowable stress in Table A-1 of ASME B31.3.*

To ensure the wall thickness is thoroughly measured, a continuous UT scan shall be conducted around the circumference of the pipe weld areas.

- 12.7.2 To further minimize the possibility of "burn through", no welding shall be allowed in areas with a wall thickness below 5 mm or below the pressure design thickness of the piping being tapped. Welding can be carried out on pipelines, vessels or equipment containing hydrocarbon, only when there has been no opportunity for air to enter the line and therefore, no possibility of them containing a combustible mixture.
- 12.7.3 Establishing flow during welding is not mandatory for header pipe with thickness 0.5 inches and larger. High flow rates should be avoided especially on liquid lines, as their cooling effect will be detrimental to the weld.
- 12.7.4 In cases where a pipeline has been cut or ingress of air has otherwise been allowed, the air must be removed from the pipeline before welding can be performed. One method of removing the air is by putting the line in service with an adequate flow rate to ensure that the air is displaced from the pipeline. Once this has been achieved, welding can proceed with or without flow.

13 Pressure Testing and Inspection

- 13.1 The Responsible Engineer shall ensure that the hot tapping equipment, the hot tap valve and branch connection have been pressure tested in accordance with this SAEP prior to commencing the actual hot tap operation.
- 13.2 The appropriate Inspection Representative shall witness and approve all hydrostatic testing required for completion of the hot tap connection.
- 13.3 Pressure Testing Media
- 13.3.1 Hot tap connections installed on hot lines where hydrostatic testing with water is not practical shall be hydrostatically tested using high temperature turbine oil or silicone fluid, as follows:

Line Temperature	Pressure Test Fluid	Stock No.
93 °C to 290 °C	Turbine Oil	26-001-330
		26-001-340
Over 290 °C	Silicone Fluid 200	26-010-037

Commentary Note:

Check that the hydrotest fluids used will not damage the soft seals in the hot tap valve, hot tap machine or other seals exposed to the test fluid such as the o-rings in Lock-o-ring flanges. For example, EPDM seals used for steam and water service can be damaged by exposure to mineral oils.

- 13.3.2 Pneumatic testing of hot tap connections on hot lines over 93°C is not permitted unless approved by the Manager, Consulting Services Department.

13.4 Hot Tap Machine

- 13.4.1 Shop pressure test every 12 months.
- 13.4.2 Replace the main packing seal and hydrotest after the machine has been used on sour or highly corrosive fluids.
- 13.4.3 Replace the main packing seal and hydrotest after it has been used on lines with operating temperatures in excess of 150°C.
- 13.4.4 A stamped brass tag shall be affixed to the hot tap and stopple equipments machine indicating the test pressure, maximum operating pressure, overhaul date, and the name of the testing organization.
- 13.4.5 The initial pressure testing of the hot tap machine, will take place in the shop after the machine has been checked and worn parts replaced.

13.5 Hot Tap and Stopple Adaptors

All adaptors must be marked with their maximum operating pressure and test pressure. They must be visually inspected for corrosion or mechanical damage before use and shall be hydrotested every five years.

13.6 Hot Tap Valve

- 13.6.1 A body and high pressure seat test (on both sides of the seat) shall be performed in the shop on all hot tap valves prior to installation.
- 13.6.2 Resilient (soft) seat valves shall have zero leakage.
- 13.6.3 Valves with metal to metal seats shall meet the leakage criteria of API STD 598.
- 13.6.4 A tag shall be attached to the valve indicating test date, test pressure and Inspector's name.

Commentary Note:

Sandwich valves only require the body test and a test of the seat on the hot tap machine side of the valve.

- 13.6.5 The seat of the hot tap valve shall be leak tested after installation by applying pressure through the branch connection boss. The test pressure shall be the lower of the expected line pressure during hot tapping plus 10% or the test pressure as calculated in 13.4.1 or 13.4.2 as appropriate.

Commentary Note:

This valve seat test cannot be performed when hot tapping a weld boss because there is no room for the test connection. In this case, the hot tap valve will be seat tested on site immediately prior to installation.

13.7 Stopple Equipment

- 13.7.1 Stopple heads shall be disassembled and all components including bolts inspected for cracks prior to each usage when the operating pressure exceeds 50% of the stopple head rated pressure. The inspection will be by magnetic particle inspection or dye penetrant.
- 13.7.2 Stopple heads shall be pressure tested in a purpose built test vessel to the manufacturers original test pressure every five years or whenever they are to be used at a pressure above 60% of their design working pressure.
- 13.7.3 The lip seal on the back of the sealing element shall be cut to ensure that the test pressure is exerted over the full area of the nose piece which will be the worst case scenario during actual usage.
- 13.7.4 The length of each of the nose piece bolts must be measured with a micrometer before and after the pressure test to ensure that yielding has not occurred.
- 13.7.5 An increase in bolt length will indicate that the test pressure and hence design pressure is incorrect or the bolt tightening torque is too high.
- 13.7.6 The nose piece bolts shall be tested by magnetic particle inspection or dye penetrant subsequent to the pressure test.
- 13.7.7 Stopple cylinders shall be pressure tested prior to each usage.

13.8 Hot Tap Connections

13.8.1 After installation of the branch connection, but prior to installing the reinforcing pad or full encirclement reinforcement, a pressure test shall be applied to the branch connection.

13.8.2 The test pressure of the branch connection shall comply with SAES-L-150 requirements. Also, this test pressure shall not exceed the maximum pressure per Table-2 "Hot Connection Pressure Test Formulas"

Table-2 utilizes with modification the results of PRCI Report # 175, "Proof Testing of the Pre-Hot-Tap Branch Connection".

13.8.3 In case that the calculated branch test pressure is less than the piping system test pressure, all welds of the pressure containing branch connection, longitudinal and circumferential welds, must be inspected by magnetic particle inspection. Also, the flange to branch weld must be inspected by 100% radiograph.

Efforts should be made to achieve the piping system test pressure by raising the header pressure as required.

13.8.4 The split tee (Types 3 & 9 of Standard Drawing # AB-036719) shall have a blind flange installed and pressure applied through the welding boss as shown on Std. Dwg. AB-036719.

13.8.5 During testing of split tee connections, the actual line pressure at the time of the test must be confirmed from a calibrated pressure gauge on the pipeline close to the hot tap connection or by any other acceptable means.

This is very critical for split tee case and for stub-in connection D_b / D_h larger than 0.5.

13.8.6 The reinforcing pad and reinforcing sleeve should not be subject to pressure testing as they are required to provide mechanical reinforcement and not to contain internal pressure.

Commentary Note:-

The weep hole in the pad or sleeve is required to prevent build up of pressure under the reinforcement and to indicate leakage of the branch connection attachment weld. The weep hole must not be threaded, as this would encourage the installation of a plug, which would defeat its purpose.

13.8.7 The achievable hydrotest pressure shall be recorded on the relevant Safety Instruction Sheet (SIS).

Table-2: Formulas for Maximum Hot Connection Pressure Test

Branch Connection Type	D_b / D_h	D_h / t_h	Formulae for Maximum Test Pressure	Applicable Notes
Split Tee Type-3 & 9	All	All	$P_b = P_h + 1.25 \Delta P$	1 & 2
Welded Stub-in Type 1, 2, 4, 5, 6, & 8	0.30 or less	50 – 60	$P_b = 0.75 \times P_f$	1 & 3
Welded Stub-in Type 1, 2, 4, 5, 6, & 8	0.30 or less	More than 60	$P_b = 0.75 \times P_f$	1 & 3
Welded Stub-in Type 1, 2, 4, 5, 6, & 8	More than 0.3	All	$P_b = 1.25 \times \Delta P + P_h$	1 & 2
Welding Boss 2 inches & smaller	All	All	$P_b = 0.75 \times P_f$	3

Notes on Table -2:

1. Branch connection types are per Standard Drawing # AB-036719.
2. ΔP is the calculated differential pressure across the pipe header per the ASME SEC VIII D1, paragraph UG-28. For this calculation, the test pressure is considered as an external pressure to the header and the value of L shall be the total length of the split tee or d_b the inside diameter of the welded stub-in connection.
3. The formula is $P_f = (16/3)(t_h/d_b)^2 S_y$ which considers the header section subject to pressure test as a flat plate.

Commentary Note:

A 0.75 factor has been introduced to insure that section will not be subject to yield. The formula gives very high pressure for testing compared to others for small branch connections.

4. Nomenclatures used in the table:
 - D_h : Header outside diameter
 - D_b : Branch outside diameter
 - d_b : Branch inside diameter
 - t_h : Header pipe wall thickness

- t_b : Branch pipe wall thickness
- P_h : Header pipe pressure
- P_b : Branch pipe test pressure
- P_f : Pressure for flat plate
- S_y : SMYS of header pipe material

Commentary Notes on Table-2:

- *PRC Report # 175 "Proff Testing of the Pre-Hot-Tap Branch Connection", 1989 contains detailed analysis of stress level in the hot tap joints under pressure testing.*
- *For these connections, the stresses due by header pressure are additive to the stresses due to the branch pressure so the highest branch test pressure will be when the header pressure is zero.*
- *The calculated test pressure will almost always be less than the required test pressure for the piping system.*

13.9 Final Hot Tap Assembly Testing

13.9.1 After installation of the hot tap machine, a final leak test of the entire assembly shall be made with the hot tap valve in the open position by applying pressure through the branch connection boss. The test pressure shall be the lower of the expected line pressure during hot tapping plus 10% or the test pressure as calculated in 13.9, 13.10 or 13.11 as appropriate.

13.9.2 After completion of the above tests, a bar stock plug shall be installed in the branch connection boss and seal welded. At the option of the Inspector, an MT or PT test may be applied to the branch connection seal weld.

14 Stoppling

14.1 General Notes

14.1.1 Stopples can only be inserted in pipelines with no flow at the stopple location. Stopple plugging heads can only withstand a differential pressure once they are fully inserted in the pipeline. If any significant differential pressure develops before full insertion is achieved, the stopple insertion equipment will be damaged and it may be impossible to retract the stopple head. The no flow condition is normally achieved on pipelines in service by diverting flow through a full flow bypass.

- 14.1.2 When a section of pipeline is isolated with two stopples and a bypass, the downstream stopple must be inserted first to divert flow through the bypass before inserting the upstream stopple. When retracting the stopple heads after pressure equalization, the upstream stopple shall be retracted first.

Commentary Note:

Inserting the downstream stopple first will divert the flow from the pipeline to the bypass. Stopple heads can withstand a small differential pressure when inserted in the reverse direction of flow. Inserting the downstream stopple first uses this feature to create the small differential pressure required to divert flow to the bypass, which must be large enough and short enough to carry the full flow with minimal pressure differential.

- 14.1.3 Stopples cannot be guaranteed to seal 100%. A small amount of leakage should be expected and a secondary barrier with a bleed connection between the stopple and the secondary barrier should be planned for. The secondary barrier could be a balloon and mud pack, sealing scraper, mechanical plug or similar device.

Revision Summary

13 November 2005	Major revision. Also, SAEP-315 and SAES-L-052 are incorporated into this SAEP-311 and eventually cancelled.
28 December 2005	Editorial revision.

Appendix A – Applicable Forms

Appendix-A.1 – Ultrasonic Thickness Measurements

Hot Tap # _____
J.O./W.O. _____ PLANT # _____ DWG. # _____
Description (Job, Location, etc.) _____

Diameter	Grade	Schedule	Flange Rating
HEADER: _____	_____	_____	_____
STICKER: _____	_____	_____	_____
HEADER MEASUREMENTS (CONTINUOUS SCANNING) Point A Min: _____ Max.: _____ Circle B Min: _____ Max.: _____ Circle C Min: _____ Max.: _____ Line D-D Min: _____ Max.: _____ Line E-E Min: _____ Max.: _____ 180 deg. from Pt. A Min: _____ Max.: _____			
STICKER MEASUREMENT Min: _____ Max.: _____			
			LOCATION-----DESCRIPTION Point A-----Branch Center Circle B-----Branch Diameter Circle C-----Reinfr. Pad Dia. Line D-D-----Reinfr. Sleeve Ends Line E-E-----Reinfr. Sleeve Ends
RESPONSIBLE INSPECTION UNIT:			INSPECTOR:

Appendix A.2 – Form 7627: HOT TAP AND STOPPLE DATA AND CALCULATION SHEET (1/2)

HOT TAP/STOPPLE & REINFORCEMENT CALCULATION REQUEST

Saudi Aramco 7627-ENG (11/98) 726-300 (Inspection Department) Page 1 of 2

SECTION 1 (to be completed by the Initiating Engineer)	
Initiating Engineer _____	Phone Number _____ Fax Number _____
Organization _____	Mailing Address _____
Hot Tap Number _____	Date Initiated _____
Hot Tap Location	
1.1) Area _____	
1.2) Plant name _____	
1.3) Plant number _____	
1.4) Header type (hydrocarbon flowline, gas transmission, process pump station, etc.) _____	
1.5) Header line number or equipment number _____	
General Information	
1.6) JO/WO number _____	
1.7) Hot tap location	
a) Off-plot or on-plot? _____	☐ Yes ☐ No
b) if off plot, within 150 meters from critical equipment? _____	
1.8) Reference drawings _____	
1.9) Approximate hot tap date _____	
1.10) Tie-in of new construction? _____	☐ Yes ☐ No
Header Piping Information	
1.11) Header size _____	Header flange rating _____
Branch Piping Information	
1.12) Size _____	Wall thickness (schedule) _____ Material specification _____
1.13) Branch or fitting flange rating (lbs.) _____	
1.14) Is a Type-3 reinforcement* requested? _____	☐ Yes ☐ No (record length - _____)
1.15) Is a Type-9 reinforcement* requested? _____	☐ Yes ☐ No (record length - _____)
1.16) Is the branch positioned vertical on top of the header? _____	☐ Yes ☐ No
*refer to Standard Drawing AB-036719	
On-Site Test Information (actual readings)	
1.17) Header flow rate during welding _____	
1.18) Header pressure during welding or coupon cutting _____	
1.19) Total sticker/fitting test pressure (lowest of 4.4c, 4.4e, or 4.6) _____	
1.20) Header pressure during hydrotest _____	
Remarks _____	

SECTION 2 (to be completed by the Operations Engineer)	
Operations Engineer _____	Phone Number _____ Fax Number _____
Organization _____	Mailing Address _____
Operating Data	
2.1) Fluid in header/tank	
a) Hazardous material in fluid _____	
b) Concentration _____	
2.2) Operating temperature _____	
2.3) MAOP or design pressures _____	
Remarks _____	

Appendix A.2 – Form 7627: HOT TAP AND STOPPLE DATA AND CALCULATION SHEET (2/2)

HOT TAP/STOPPLE & REINFORCEMENT CALCULATION REQUEST

Saudi Aramco 7627-ENG (11/98) Reverse 726-300 (Inspection Department) Page 2 of 2

SECTION 3 (to be completed by Inspection)			
Inspector	_____	Phone Number	_____ Fax Number _____
Organization	_____ Mailing Address _____		
Hot Tap Location			
3.1) Pipe size	_____	Flange rating	_____
3.2) Pipe type	☐ seamless ☐ spiral		☐ SAW
3.3) Material specification	_____	Grade	_____
3.4) UT thickness readings: Minimum	_____	Maximum	_____
3.5) Date UT readings taken	_____ must be completed within 30 days of the hot tap or stopple)		

SECTION 4 (to be completed by the Engineering organization responsible for the hot tap or stopple)			
Engineer	_____	Phone Number	_____ Fax Number _____
Organization	_____ Mailing Address _____		
Design Calculations			
4.1) Branch reinforcement types per Standard Drawing AB-36719	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9		
4.2) Allowable header pressure during welding	Maximum	_____	
4.3) Velocity of commodity in header being cut	Maximum	_____	Minimum _____
4.4) a) Expected header pressure during test	_____		
b) Maximum allowable external pressure (for stoppling it is determined by the stopple fitting length)	_____		
c) Total of 4.4a and 4.4b	_____		
d) Valve seat pressure limit	_____		
e) Branch flange/wall test pressure limit	_____		
4.5) Valve seat test pressure (use the lower of 4.4c, 4.4d for an on site test, and 4.4d for a shop test)	_____		
4.6) Valve body/fitting test pressure (lowest of 4.4c or 4.4e for an on site test and 4.4e for a shop test)	_____		
4.7) Is hydrostatic test pressure of the valve body/fitting less than the system hydrostatic test?	☐ Yes ☐ No*		
*if yes the hydrostatic test shall be approved by _____ General Supervisor or Superintendent Operations Engineering			

FINAL HOT TAP CALCULATION APPROVAL	
Design Supervisor	_____
Supervisor Operation Engineering	_____
cc: Area Loss Prevention Engineer	
Responsible Operations Inspection Unit	

ADDITIONAL APPROVALS REQUIRED FOR A "NO-FLOW" HOT TAP	
Project Manager	_____
General Supervisor or Superintendent Operation Engineering	_____

Appendix A.3 – Form 7235: HOT TAP DATA AND CHECKLIST

HOT TAP DATA & CHECKLIST

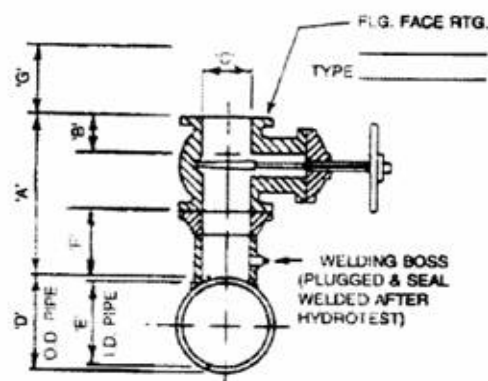
Saudi Aramco 7235-ENG (11/98) 726-300 (Inspection Department)

SAEP-311

Work Order No.:				
Hot Tap/Tie In No.:				
Job Number:		Scaffold Erected	Yes ☐	No ☐
Job Location:		H/T in Restricted Area	Yes ☐	No ☐
Plant Number:		Offroad Vehicle Required	Yes ☐	No ☐
Plant Access No.:		Stopple Required	Yes ☐	No ☐
Plant ID Required:		Guide Bar Required	Yes ☐	No ☐
		LOR Plug Required	Yes ☐	No ☐

To be completed by the Inspection Unit				
HYDRO Completed After Installation of Valve on Sticker:		Yes ☐	No ☐	
	NAME	BADGE#	DATE	SIGNATURE
HYDROWITNESSED BY:				
UT Readings:				
Min:	Max:			

NOTE: 1. Two weeks notice shall be given for all Hot Taps upon completion of this checklist.
2. Proponent is to provide metals crew, welder, crane, bolts, gaskets, scaffold, and welding & hydrotest equipment necessary.



"G"- MACHINE CLEARANCE REQUIRED

Model 360 (1" thru 6") = 5 FT.
Model 660 (3" thru 8") = 7 FT.
Model 760 (3" thru 12") = 10 FT.
Model 1200 (10" thru 30") = 12 FT.
Model 1200XL (30" thru 42") = 16 FT.
Model 2400 (30" thru 60") = 20 FT.

Branch Type:	Pipe Type:	Mat'l GR:
☐ Split Tee	☐ SAW Str.	☐ B
☐ Full Encirc.	☐ Seamless	☐ X42
☐ Pad Reinf.	☐ SAW SPR	☐ X52
☐ Weld Boss	☐ Other _____	☐ X60
		☐ Other _____

Header		Valve Gate/Ball	A	B*	C**	D	E	F	Product	During Hot Tap		
Size	Thick									Press.	Temp.	Velocity

*Minimum distance with valve in closed position (From top of ball if Ball Valve.)

**Minimum diameter cutter can pass thru.

Were above dimensions physically taken?:

☐ Yes ☐ No

Hot Tap Position: _____ ° (angle)
Header Position: ☐ Vertical ☐ Horizontal
Hot Tap Elevation: _____ (meters/feet)
H2S Concentration: _____ %

Hot Tap Required Date: _____
Hot Tap Requester:
Name: _____
Tel.: _____
Fax.: _____

Appendix B –Typical Hot Tapping Execution Sequence

Step	Procedure	Responsibilities
B.1	Review the design drawings and requirements for the branch connection, including an approved welding procedure in accordance with SAES-W-011 or SAES-L-012 as applicable.	Init. Eng/Insp
B.2	Ensure all the requirements of paragraph 3.2 "General Requirements" are met.	Init. Eng/Maint/ Constr
B.3	Check that the location of the installation is that location specified by the initiating Engineer with the concurrence of the Operations Supt.	Opers/Maint/ Constr
B.4	Obtain an approved Hot Work Permit, Saudi Aramco Form SA 924-2 (Para. 3.7.3) from the Operations Superintendent, or his designee, prior to starting with work.	Init. Eng/Maint/ Constr
B.5	If long seam is under hot tap fitting, grind seam weld flush with the surface of the pipe taking care not to reduce the pipe wall thickness. Check pipe wall thickness ensuring it does not violate paragraph 12.1.	Maint/Insp/ Constr
B.6	Ensure the pressure and flow requirements as identified in section 4 of Form SA 7627-ENG have been established prior to any welding.	Init Eng/Insp/ Maint/Constr Opers
B.7	Power wire brush the area for attachment welds to remove all traces of paint, rust and scale. The fit-up of the connection to the header shall provide for a standard pipe bevel and 1/16 inch minimum root gap. Install the nozzle or boss connection using full penetration welds in the exact location shown on the approved drawing, using a qualified welder and a CSD approved welding procedure. The Inspection Unit will verify proper weld joint fit-up.	Maint/Constr/ Insp
B.8	Ensure that the nozzle connections are not welded on the inside unless the hot tap cutter is at least one pipe size smaller than the nozzle. The cutters sometimes break if the cut is made through a weld.	Insp/Init Eng/ Maint/Constr
B.9	Pre-check the tapping valve and the hot tap machine to assure good operable condition, including the cutter and coupon retaining device.	Hot Tap Unit
B.10	Confirm that the shop rating test of the hot tap machine is current per section 13.	Insp/Hot Tap Unit
B.11	Mount the valve on the fitting ensuring that its alignment is within the manufacturer's tolerance	Insp/Hot Tap Unit
B.12	Close the valve and perform the hydrostatic test according to this instruction.	Maint/Constr/Hot Tap/Insp
B.13	Check the valve by opening and the hot tap machine for operability and examine the condition of the cutter and coupon retaining device.	Hot Tap Unit/Maint/ Constr

Appendix B – Typical Hot Tapping Execution Sequence, continue

Step	Procedure	Responsibilities
B.14	Mount the hot tap machine on the valve.	Hot Tap Unit/Maint/ Constr
B.15	Ensure that the tapping valve is tested in accordance with paragraph 13.7 and will easily pass the hot tap cutter. This may require grinding of the lugs on the valve seat rings to provide adequate clearance. Ensure that the dimension from the face of the valve flange to the surface to be hot tapped will permit enough cutter travel to completely cut out the coupon and not travel to the opposite side of the header.	Hot Tap Unit/Insp
B.16	Apply hydrostatic and pneumatic pressure tests to the hot tap machine, valve, and welded connection in accordance with the testing procedure specified in this SAEP.	Hot Tap Unit/Insp/ Maint/Constr
B.17	Install and seal weld a threaded plug in the weld boss on the connection after all testing has been completed. Refer to section 13.	Maint/Constr
B.18	After assembly of the hot tap machine on the tapping valve and before the tapping operation is started: Completely close and then completely open valve to ensure that it is operable, and that the cutter can be withdrawn a sufficient distance to permit closure of the valve. Set the cutter travel indicator to prevent over travel and consequent damage to the opposite side of the header being hot tapped.	Hot Tap Unit
B.19	Drill and cut coupon.	Hot Tap Unit
B.20	Retract the hot tap machine boring bar.	Hot Tap Unit
B.21	Close the valve, purge with nitrogen, if required, and depressurize the hot tap machine adaptor.	Hot Tap Unit
B.22	Remove the hot tap machine from the line.	Hot Tap Unit/ Maint/Constr
B.23	Remove the coupon from the pilot drill and tag and wire the coupon to the tapping valve on the connection after hot tap is completed.	Hot Tap Unit/ Maint/Constr
B.24	The coupon shall be removed only by the Operations Supervisor and forwarded to the responsible Operations Inspection Unit.	Opers
B.25	Ensure that the completed connection is blinded or plugged before leaving the job site.	Hot Tap Unit/Insp/ Maint/Constr

Appendix C – Typical Stoppling Operation Sequence

C.1: First Section: Stopple Fitting / Sandwich Valve Installation Procedure

Step	Procedure	Responsibilities
C.1.1	Check that the matched ends of the stopple fitting are identified by painted bands or other match marks.	Proponent Inspection
C.1.2	Check that the location of the installation is that specified by the Initiating Engineer with the concurrence of the Operations Supt. Also, ensure that the specified operating conditions prevail during welding.	Initiating Eng./ Operation Maintenance Construction Unit
C.1.3	Grind seam weld flush with the surface of the pipe taking care not to reduce the pipe wall thickness.	Maintenance Construction Unit
C.1.4	Clean the area of the connection attachment welds using a powered wire brush to remove traces of paint, rust and scale.	Maintenance Construction Unit
C.1.5	Check the locking segments on the stopple fitting flange for cleanliness and operability. Also, ensure the stopple cutter and O' ring dimensions match the bore of the stopple fitting.	Hot Tap and Stopple Unit
C.1.6	Assemble top and bottom halves of the stopple fittings taking care that painted bands or the match marks of the halves are matched. Fit up tolerance to be 3.2 mm (1/8 in) + .8 mm (1/32 in).	Maintenance Construction Unit
C.1.7	Check the level and alignment of the stoppled fitting.	Hot Tap and Stopple Unit
C.1.8	Ensure the pressure and flow requirements as identified in section 4 of Form 7627-ENG have been established prior to any welding.	Initiating Eng./ Inspection Unit / Maintenance/ Construction Unit
C.1.9	Tack weld top and bottom fitting halves at longitudinal bevels only (not to pipe) by using welding back up strips.	Maintenance/ Construction Unit
C.1.10	Complete longitudinal butt welds.	Maintenance/ Construction Unit
C.1.11	Complete circumferential fillet weld at one end of the fitting in accordance with design requirements.	Maintenance/ Construction Unit
C.1.12	Allow the weld and the fitting to air cool to below 121°C before completing the fillet weld at other end of the stopple fitting.	Maintenance/ Construction Unit
C.1.13	Mount the sandwich valve on the fitting ensuring that its alignment is within the manufacturer's tolerances.	Hot Tap and Stopple Unit
C.1.14	Mount a blind flange on the stopple fitting and perform hydrostatic test as per hydrostatic test pressure as specified on Form 7627-ENG and confirm that the operating conditions are maintained at the values specified on this form.	Hot Tap and Stopple Unit/ Inspection Unit
C.1.15	Witness the hydrostatic test pressure as specified on Form 7627-ENG and confirm that the operating conditions are maintained at the values specified on this form.	Initiating Engr./ Inspection
C.1.16	Close the sandwich valve and perform the hydrostatic test in compliance with this instruction.	Maintenance/ Construction Unit/ Inspection Unit
C.1.17	Install and seal weld a threaded plug in the hydrotest connection on the stopple-fitting after all testing has been completed and the fitting is drained.	Maintenance/ Construction Unit

C.2: Second Section: Hot Tap Operation associated with stopple operation

Step	Procedure	Responsibilities
C.2.1	Check the sandwich valve by opening and the hot tap machine for operability and examine the condition of the cutter and coupon retaining device.	Hot Tap and Stopple Unit
C.2.2	Mount the hot tap machine on the sandwich valve.	Hot Tap and Stopple Unit Maint./Const. Unit
C.2.3	Completely close and then completely open the sandwich valve to ensure that it is operable.	Hot Tap and Stopple Unit Maint./Const. Unit
C.2.4	With the sandwich valve fully open hydrostatic test the entire assembly to ensure that the gaskets and seals are holding the pressure as per hydrostatic test pressure as specified on Form 7627-ENG and confirm that the operating conditions are maintained at the values specified on this form.	Hot Tap and Stopple Unit Maint./Const. Unit / Inspection Unit
C.2.4	Set the cutter travel indicator to prevent over travel and consequent damage to the header being hot tapped.	Hot Tap and Stopple Unit
C.2.5	Check the hydrostatic test requirements of the hot tap machine and ensure the requirements of SAEP-311 are met prior to hot tapping.	Initiating Engr.
C.2.6	Drill and cut coupon.	Hot Tap and Stopple Unit
C.2.7	Retract the hot tap machine boring bar.	Hot Tap and Stopple Unit
C.2.8	Close the sandwich valve and depressurize the hot tap machine adaptor.	Hot Tap and Stopple Unit
C.2.9	Remove the hot tap machine from the line.	Hot Tap and Stopple Unit Maintenance/ Construction Unit
C.2.10	Remove the coupon from the pilot drill and verify the pipe wall thickness to confirm that the stopple sealing element has been machined to the correct size. The coupons shall be tagged and submitted to the responsible Operations Inspector.	Hot Tap and Stopple Unit
C.2.11	Hydrotest and hot tap the special equalization connection. Details of the hydrotest are referenced in SAES-L-150	Proponent Inspection /Maint./Construction Unit/Hot Tap and Stopple Unit

C.3: Third Section: Stopples Operation

Step #	Procedure	Responsibilities
C.3.1	Mount the stopple plugging machine onto the sandwich valve.	Hot Tap and Stopples Unit Maintenance / Construction Unit
C.3.2	Check hydrostatic test requirements.	Initiating Engr.
C.3.3	Install rigid steel piping between the stoppling machine and the equalization connection.	Hot Tap and Stopples Unit
C.3.4	Equalize pressure and fully open the sandwich valve. (Sandwich valves are not designed to be opened/closed under differential pressure.)	Hot Tap and Stopples Unit
C.3.5	Insert the stopple plugging head the calculated distance required to plug the line.	Hot Tap and Stopples Unit
C.3.6	De-pressurize the isolated section of the pipeline via the equalizing valve ensuring there is no stopple leaks.	Hot Tap and Stopples Unit Operations
C.3.7	Perform the required work on the pipeline in accordance with SAEP-310 (e.g., cold cut line, fit new pipework, welding, NDE, etc.)	Maintenance/ Construction Unit
C.3.8	Fill the new isolated section of the pipeline with the contents of the system. Ensure that the pressures on both sides of the stopple plugging head are fully equalized.	Hot Tap and Stopples Unit Operations
C.3.9	Retract the stopple plugging head and close the sandwich valve.	Hot Tap and Stopples Unit
C.3.10	Remove stopple plugging machine from the line.	Hot Tap and Stopples Unit Maintenance / Construction Unit
C.3.11	Attach the stopple completion plug with the coupon attached, to the hot tap machine.	Hot Tap and Stopples Unit
C.3.12	Mount the hot tap machine onto the sandwich valve and open the valve and insert the stopple completion plug. Ensure that pressures are equalized before inserting or retracting completion plugs.	Hot Tap and Stopples Unit Maintenance/ Construction Unit
C.3.13	Check hydrostatic test requirements of the repaired pipeline.	Initiating Engr.
C.3.14	Depressurize the hot tap machine and check for leakage past the completion plug.	Hot Tap and Stopples Unit
C.3.15	Remove the hot tap machine and the sandwich valve.	Hot Tap and Stopples Unit Maintenance/ Construction Unit
C.3.16	Insert the special plug for the equalization connection and remove the temporary valve.	Hot Tap and Stopples Unit
C.3.17	Ensure that all completed connections are blinded or capped before leaving the jobsite. This shall be the joint responsibility of the Producing/Manufacturing Operations Superintendent, Pipelines Operations Superintendent, and the Pipelines Maintenance Superintendent for work done in or up to 0.5 km from a facility and the Pipelines Operations Superintendent and the Pipelines Maintenance Superintendent for work done beyond 0.5 km from a facility.	Operations/ Maintenance/ Construction Unit