

## **SAGD Steam Injection & Letdown Valves**

### **Challenges**

In the oils sands of Alberta, Canada there is an abundance of hydrocarbons that lie beneath permeable overburden or are not recoverable due to environmental issues. The process of in-situ thermal recovery, or SAGD (Steam Assisted Gravity Drainage), has proven effective in the recovery of the bitumen (heavy oil) deposits that are found in Northern Alberta with the first commercial SAGD project built in 1996 outside of Cold Lake. This process involves the injection of steam in an upper well and the recovery of heated bitumen that flows out of the formation along with water as a result of condensation of the steam via a second, lower well.

Water consumption in this method of enhanced oil recovery (EOR) can be quite high. As a result the sites are required to recycle produced water from the wells through water treatment facilities. The resulting water used in both the water and steam systems is never clean, and contains contaminants and mineral byproducts.

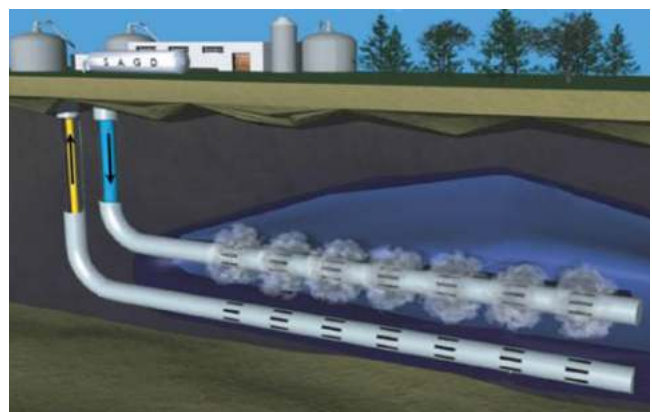
The majority of SAGD facilities will use once-through steam generators (OTSG) for their steam production. The steam from these OTSGs is piped to steam letdown valves, which drop the pressure to injection valves that inject the steam into the well pad. The steam pressures are quite high and the steam quality is typically low, which creates challenges that must be met with engineered solutions.

Some of these challenges include:

- **Low Quality Steam**
- **High Pressure Differential**
- **Tight Shutoff Requirement**
- **Packing Integrity**
- **Process Contamination**



**Trimteck's Optimux  
OpGL-XT Control  
Valves at an Alberta  
SAGD Plant**



## Trimteck's Solution

Trimteck has developed engineered solutions that are able to address the specific challenges of steam injection valve applications in SAGD. The key for Trimteck was a focus on providing a cost-effective solution based upon previous failures experienced on competitive offerings. The solutions to these challenges are:

### ■ Low Quality Steam

Typically the steam in these systems starts wet and only get wetter as it is piped from the location of the OTSG to the well pad site. The reduction of pressure through both the steam letdown valve and injection valves only decrease the quality of the steam creating a higher volume of water within the process. The two-phase nature of the process creates an issue because the liquid water is highly erosive as it is carried at high velocities.

Some manufacturers try to use complex tortuous path retainers – which can be quite helpful in cavitating service – to control a flashing process. No matter how many stages or reductions are taken, in flashing service the pressure drop will result in the liquid within the process flashing from a liquid form to gaseous form, carrying with it the remaining liquid droplets at high velocity through the retainer and into the trim itself. Trimteck recognizes that a valve should be designed to handle the process as simply and elegantly as possible, without the over-engineering that results in a high-cost solution, which may not be ideally suited for the service. In fact, designs using small torturous path orifices are susceptible to clogging due to system contamination, variability in the system, or inadequate flushing of the line prior to operation. Due precisely to this recurring issue, Trimteck uses an angle style valve engineered with an extended Venturi seat ring to displace the erosive vapor bubbles when the process drops below the vapor pressure downstream of the valve. This method effectively protects the trim and body.

Due to the erosive and corrosive nature of the process, it is critical that the proper materials of construction are selected. In most cases a 400 Series Stainless Steel with our proprietary CVD-5B hardening process will satisfy the

### Trimteck® ST-1 Single Stage Anti-Cavitation Trim



application, but in rare cases where high temperature and/or elevated chlorides are present Inconel with CVD-5B will be used. CVD-5B is a chemical vapor diffusion process utilizing our proprietary boron compound, and creates



To learn more about CVD-5B, visit [trimteck.com](http://trimteck.com)

a hard wear-resistant metal mesh that is fused into the entire surface of the trim component, thereby providing superior protection against erosion and corrosion.

### ■ High Pressure Differential

On smaller valve sizes Trimteck uses a high rangeability, unbalanced design with a Venturi seat ring that allows the liquid embedded in the steam to flash downstream of the valve trim components. On larger valves, Trimteck uses its ST-3 Noise Attenuation Trim to abate the noise and piping vibration, while staging the pressure drop across the valve and allowing the flashing of the entrained fluid through the Venturi seat ring. By ensuring that the holes in the staged concentric cylinder, pressure-reducing retainer are sized to allow for entrained erosive particles and vapor bubbles, the Trimteck offering is resistant to the plugging that can occur due to system contamination or upsets.

### ■ Tight Shutoff Requirement

Providing tight shutoff in the SAGD steam injection valves is critical to the overall performance of the system, and to maintain the highest possible quality of steam. Trimteck uses a high thrust OpTK piston cylinder actuator to provide tight shutoff. The actuator also has superior stiffness to that of a diaphragm actuator allowing for flow of the process over-the-plug, and utilizing the differential pressures to assist in shutoff. Moreover, the Trimteck design has a clamped-in, self-centering seat ring. The clamped-in seat ring self-aligns to the plug during the assembly process eliminating any need for lapping. This feature, along with different seating angles between the

plug and seat ring, allows the shutoff force to be focused at a single point, thereby providing a much tighter metal-to-metal seal with a typical shutoff off the test bench of Class VI, and Class V in process.

### ■ Packing Integrity

There is typically a high level of NaCl contaminants in SAGD steam applications due the use of recycled water, not to mention the multitude of other contaminants that can be found. Due to these, there is the potential for packing leaks to occur, however, Trimteck offers its PT Fugitive Emissions HT packing, along with an Inconel scraper ring. The Inconel scraper ring is a small sharp edged Inconel ring that is designed with a knife edge to scrape scale and buildup off of a plug stem, which if left on the stem can damage the packing. Also, the Trimteck design is double-top stem guided, which provides rigid support to a packing box that has both upper and lower packing, resulting in longer-lasting packing integrity.

### ■ Process Contamination

SAGD steam injection services are rarely clean and contain contaminants that can be either process-related or the result of accidental introductions. Process-related contaminants, such as sand or corrosive byproducts that can cause a reaction with the piping materials, are typically assumed at the early stages of engineering and accounted for in the valve design. Contaminants that are

**Trimteck® ST-3**  
**Noise Attenuation Trim**



**Trimteck® ST-5**  
**Venturi Seat for Flashing Service**



accidentally introduced to the system cannot be predicted. Therefore, in the design stage Trimteck makes allowances for flushing processes during startup and installation of in-line screens, thus our trim design is simple and lacks small, tortuous passageways that can become clogging issues.

Lastly, and perhaps most importantly, the use of this simple ST-3 Noise Abatement Retainer and ST-5 Venturi Seat design allows for more field-friendly solution, which can be easily replaced and re-worked if the conditions demand it.

### Recent SAGD Solutions Engineered by Trimteck®

Application	HP Steam Separator	Heel Steam Flow Control	Toe Steam Flow Control	Steam Let Down
<b>Valve Model &amp; Body Type</b>	OpGL-XT Angle Body Globe	OpGL-XT In-Line Globe	OpGL In-Line Globe	OpGL-XT Angle Body Globe
<b>Size &amp; Pressure Rating</b>	2" CL900	3" CL900	2" CL900	2" CL900
<b>Body Material</b>	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel
<b>Trim Type</b>	ST-5 Venturi Seat for Flashing Service	ST-3 2-Stage Noise Abatement	ST-3 2-Stage Noise Abatement	ST-5 Venturi Seat for Flashing Service
<b>Trim Material</b>	420SS w/CVD-5B	420SS w/CVD-5B	420SS w/CVD-5B	420SS w/CVD-5B

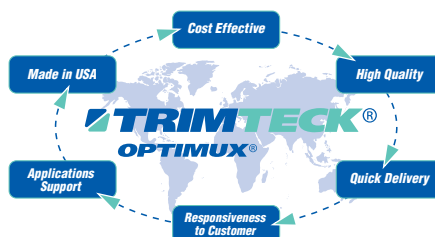
## About Trimteck

Trimteck® is a NASA VDB-approved, ISO 9001-2016-registered U.S. company (Registration No. 2012-98243) with over thirty years of experience engineering, manufacturing, and marketing high-quality, cost-effective flow, pressure, and temperature control solutions and equipment for critical processes. Our products are currently helping customers safely improve quality, optimize throughput, and reduce emissions and energy costs across an array of industries in more than 50 countries.

We manufacture a comprehensive line of control valves – and variety of actuators, positioners, severe service trims, and other accessories – that our applications engineers and representatives use to solve even the most complex flow control problems quickly and economically.



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