Appendix L:
Design Specifications for Subsurface Safety Valve, Panel and Operation Manual

Operational Instructions for AGI Well 1 Control Panel

Control panel is used to control Subsurface Safety Valve (SSSV) and Wing Valve (WV)
The SSSV is located at 250 ft depth and prevents backflow up the tubing from below that depth. The SSSV serves as a check valve; fluid can be injected past the SSSV even when the SSSV has been closed. The Wing valve is located at the surface and is used control whether or not fluid can enter the well. These instructions will be updated as the connections to the panel are completed.

For emergency shutdown. (This shuts the SSSV and the wing valve)

1. Push in Red ESD/TSE handle on front of panel.
    - ESD/TSE holding pressure will immediately go to 0 PSI.
    - Wing Valve will close over 90 seconds and the output pressure should slowly drop to 0 PSI.
    - After 90 second delay, SSSV will close and SSSV output pressure will drop to 0 PSI (Hydraulic supply pressure will also drop, but may not reach 0 PSI).

To reopen SSSV and Wing Valve

1. Pull out Red ESD/TSE handle and hold for several seconds.
    - ESD/TSE holding pressure will increase to set level (~60 PSI).
    - Hydraulic pump will engage and SSSV output pressure will increase. At ~2000 PSI, the pressure will bobble (rise and fall) as the sleeve on the SSSV slides down opening the valve. Once the sleeve is in place, the SSSV output pressure will rapidly climb to just below the set pressure (~3000-3500 PSI). The pump will then slow down pump to the set level over the next several minutes.
2. Pull out Black Wing Valve handle and hold for several seconds.
    - Wing Valve output pressure will increase to set level (~* PSI; to be determined). The wing valve will slowly open until the valve is completely open.

Normal operation

<u>Red ESD/TSE pull handle & Black wing valve pull handle</u>
Handles should be out during normal operation.

<u>Panel supply pressure</u>
Panel is controlled pneumatically, Panel Supply pressure should be >30 PSI and <125 PSI. We suggest ~75 PSI. This level depends on air supply pressure and is controlled by regulator closest to panel supply (B-1 on diagram).

<u>ESD/TSE holding pressure</u>
Pressure must be >20 PSI for the proper operation of the panel. The preset is for 60 PSI. This level can be controlled using the regulator on the right hand side of the panel interior.

<u>Output pressure to SSSV</u>
Pressure should be >2500 PSI and <5000 PSI. We recommend 3000-3500 PSI. This level will fluctuate due to temperature changes (both atmospheric and injection fluid) and is controlled by the regulator next to the hydraulic pump (C-2 on diagram). While the panel supply pressure is between 30 and 125 PSI, the hydraulic pump (S-1 on diagram) should automatically engage to maintain pressure to SSSV. The pump can be manually operated (should the panel supply pressure drops below ~30 PSI), using the handle attached to the back door of the control panel.

Output pressure to wing valve
The Wing Valve output pressure should be >* PSI and <* PSI (* - to be determined). This level is determined by the wing valve and should not require adjustment as long as the panel supply pressure is sufficient for operation.

Hydraulic supply pressure valve.
The hydraulic supply pressure is linked to the operation of the SSSV and should equal the SSSV output pressure. The sight glass shows the level of hydraulic fluid and should be maintained at ~3/4 full. Fluid can be added through the fill cap on the top of the panel just above the sight glass. Use H-32 hydraulic oil.

In-Service/Bypass/Wing Valve handle
Handle should be set to In-Service during normal operation.

Maintenance

The SSSV sleeve should be exercised (activated) roughly once a month to prevent scale build-up on the SSSV and to check performance.

1. Turn the In-service/Bypass/Wing Valve handle to Bypass. This will prevent the wing valve from closing and interrupting injection.
2. Push in the red ESD/TSE handle and wait ~90 seconds until the SSSV closes (output pressure goes to 0 PSI).
3. Pull out and hold the ESD/TSE handle for several seconds. Watch the SSSV output pressure and make certain that the pressure bobbles (rises and falls) at ~2000 PSI before climbing to the set pressure. (If the pressure does not bobble, it may mean the sleeve has become stuck in the up position. Repeat the process. If it appears that the sleeve still does not descend, contact 1) Completions Manager, Baker Oil Tools, Odessa office: 432-563-1900; 3) Russell Bentley, Carbon Free Corp.: 832-630-2395; Alberto Gutierrez, Geolex: 505-842-8000.
4. Return the In-service/Bypass/Wing Valve handle to In-service.

For Help with Panel

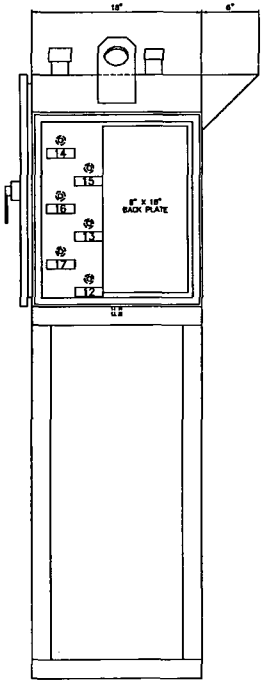
Call RSI Global – Louis Lesage 504-340-1992
Job number 2010080501

NAMETAG LIST

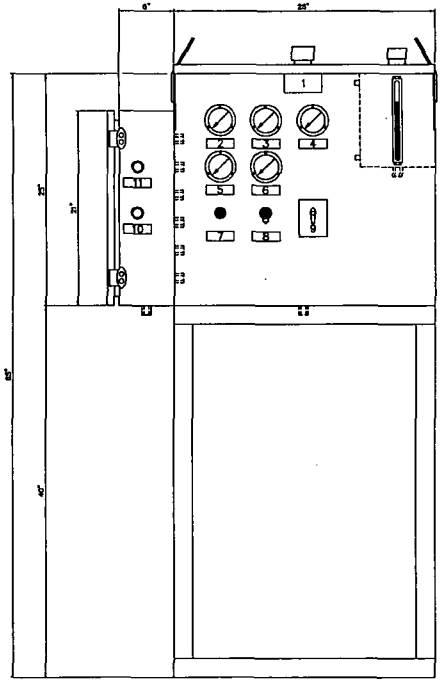
TAG #	QTY.	ITEM #	DESCRIPTION	SIZE	COLOR BACKGRND/LETTERS
1	1	---	ANADARKO LOGO TAG	2" X 4"	A/R
2	1	D-1	PANEL SUPPLY PRESSURE	1" X 3"	WHITE/BLACK
3	1	E-1	ESD/TSE HOLDING PRESSURE	1" X 3"	RED/WHITE
4	1	F-1	HYDRAULIC SUPPLY PRESSURE	1" X 3"	WHITE/BLACK
5	1	F-2	OUTPUT PRESSURE TO SSSV	1" X 3"	WHITE/BLACK
6	1	E-2	OUTPUT PRESSURE TO WING VALVE	1" X 3"	WHITE/BLACK
7	1	G-1	PULL TO CHARGE ESD/TSE PUSH FOR TOTAL SHUTDOWN	1" X 3"	RED/WHITE
8	1	H-1	PULL TO OPEN PUSH TO CLOSE WING VALVE	1" X 3"	WHITE/BLACK
9	1	CC-1	WING VALVE	DET. "A"	WHITE/BLACK
10	1	EE-1	PUSH TO OPEN WSV SOLENOID	1" X 3"	WHITE/BLACK
11	1	EE-2	PUSH TO OPEN SSSV SOLENOID	1" X 3"	WHITE/BLACK
12	2	Q-1	SSSV SOLENOID	1" X 3"	WHITE/BLACK
13	2	Q-2	WING VALVE SOLENOID	1" X 3"	WHITE/BLACK
14	2	AA-2	LOW AIR PRESSURE	1" X 3"	WHITE/BLACK
15	2	Z-1	ESD STATUS	1" X 3"	RED/WHITE
16	2	AA-1	WING VALVE STATUS	1" X 3"	WHITE/BLACK
17	2	BB-1	SSSV STATUS	1" X 3"	WHITE/BLACK
18	1	X-1	ESD STATUS	DET. "B"	WHITE/BLACK
19	1	X-2	WING VALVE STATUS	DET. "B"	WHITE/BLACK
20	1	X-3	LOW AIR PRESSURE	DET. "B"	WHITE/BLACK
21	1	Y-1	SSSV STATUS	DET. "C"	WHITE/BLACK
XX	1	XXXX	RSI GLOBAL JOB TAG	XXXXX	XXXXXXXXXX

BULKHEAD LIST

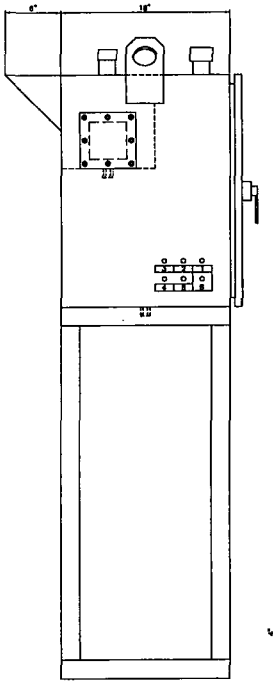
TAG #	QTY.	DESCRIPTION	SIZE	COLOR BACKGRND/LETTERS
1	2	PANEL SUPPLY	3/4" X 2"	WHITE/BLACK
2	2	DRAIN	3/4" X 2"	WHITE/BLACK
3	2	ESD/TSE	3/4" X 2"	RED/WHITE
4	2	TO WING VALVE	3/4" X 2"	WHITE/BLACK
5	2	TO SSSV	3/4" X 2"	WHITE/BLACK
6	2	(BLANK)	2" X 2"	WHITE



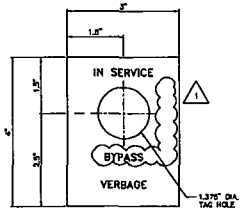
LEFT SIDE



FRONT VIEW



RIGHT SIDE



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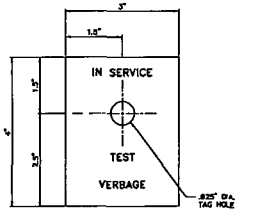

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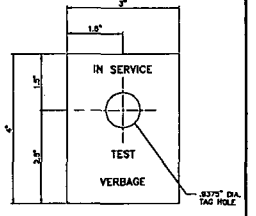


DETAIL "C"

NO.	REVISIONS DESCRIPTION	DATE	BY
1	AS-BUILT - UPDATE DRAWING	9/29/10	LL

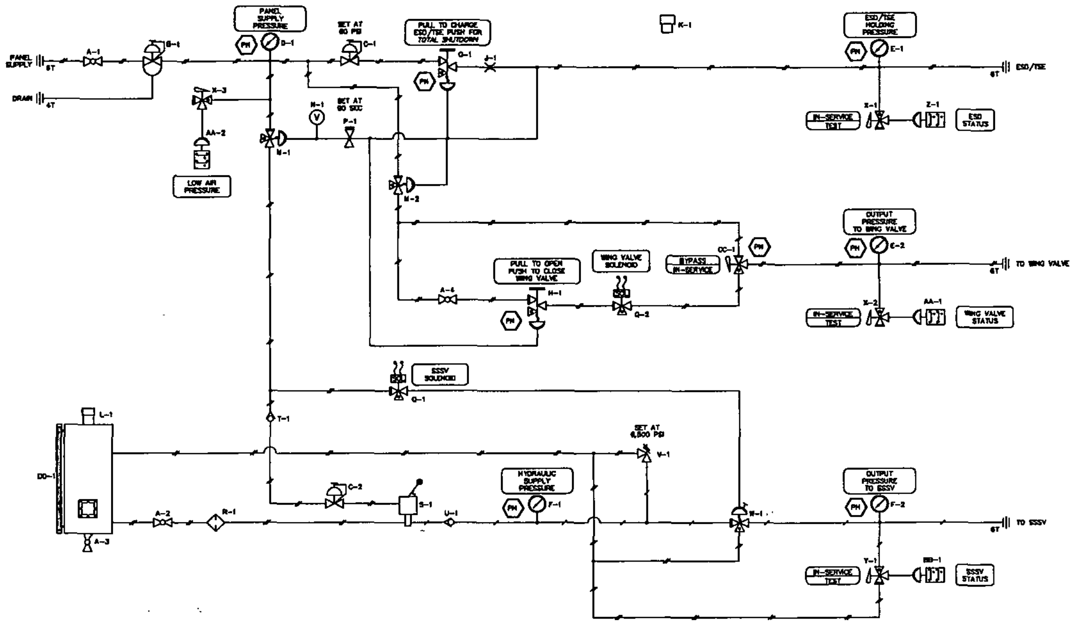
RSI Global
2063 PAXTON STREET
HARVEY, LA. 70058
(504) 340-1992

PROJECT: LL	8/18/10	
DESIGN: LL	8/18/10	
C.A.:		
DRAFTER: TN	8/18/10	

ANADARKO

SINGLE WELL CONTROL PANEL
GENERAL ARRANGEMENT

SCALE	JOB NO.	DWG. NO.	REV.
NONE	2010080501	2010080501-GA1	1

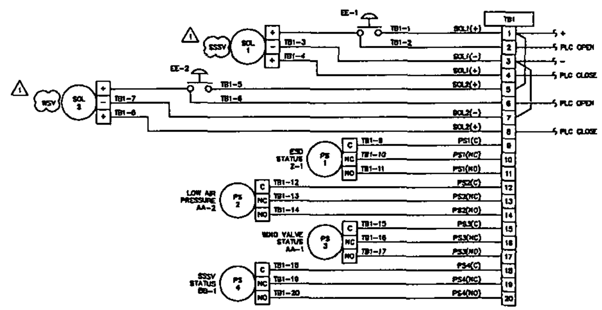


MATERIAL LIST

ITEM	QTY.	DESCRIPTION	MFG.	PART #
A	4	1/4" S.S. BALL VALVE	IN LINE	20IF-0250-M-E-05
B	1	FILTER REGULATOR W/AUTO DRAIN 1/2"	BIMBA	AF20-C4A1DCM/PMB20
C	2	REGULATOR	BIMBA	AP10-R2NK
D	1	2-1/2" PRESSURE GAUGE (0-300 PSI)	WIKA	426.2943
E	2	2-1/2" PRESSURE GAUGE (0-160 PSI)	WIKA	426.2926
F	2	2-1/2" PRESSURE GAUGE (0-10,000 PSI)	WIKA	426.3044
G	1	RELAY / P.M. NUT	RUELCO	10A1-2R200/10-006-000
H	1	RELAY W/LATCH/ P.M. NUT	RUELCO	10A1-2B200/10-008-000
J	1	.030" FIXED ORIFICE	RUELCO	80-001-0A0
K	1	FLAME ARRESTOR	RUELCO	8700-10000
L	1	FILLER CAP	RUELCO	8300-10000
M	2	3-WAY N.C. PILOT RELAY	RUELCO	16A1-20000/16-007-000
N	1	4" VOLUME BOTTLE	SUNSOURCE	VB453
P	1	1/8" FLOW CONTROL	DELTROL	EFP-10-SSB
O	2	SOLENOID VALVE	SKINNER	X5RBM5D740DC2AA4K
R	1	1/2" Y STRAINER	IN LINE	904-0438-01
S	1	8800 PSI HYDRAULIC PUMP W/ HAND PUMP	HASKEL	MHP-71
T	1	1/4" CHECK VALVE S.S. 1 PSI CRACKING	NUPRO	SS-CHS4-1
U	1	CHECK VALVE H.P. 1/4"	OLIVER	CV25HP
V	1	RELIEF VALVE 6,000 - 10,000 PSI	RUELCO	7500-20000
W	1	HYDRAULIC INTER. 10,000 PSI W/MAN OVER	RUELCO	8100-20000/80-008-000
X	3	3-WAY SELECTOR VALVE 1/8"	WHITEY	SS-42GXF2
Y	1	3-WAY SELECTOR 10,000 PSI	WHITEY	SS-HB3XPF4
Z	1	PRESSURE SWITCH 15PSIF 72" LEADS	NEO-DYN	130P42OBEHN
AA	2	PRESSURE SWITCH 80PSIF 72" LEADS	NEO-DYN	130P44OBEHNR
BB	1	PRESSURE SWITCH 4800 TO 8,300 PSI	NEO-DYN	232P43CC6REH
CC	1	3-WAY SELECTOR VALVE	WHITEY	SS-43GXF4
DD	1	8" SIGHT GLASS	LUBE DEVICE	0607-8-A-1-1/4"
EE	2	MOMENTARY PUSH BUTTON	STAHL	8003/112-001/8602823840

MATERIAL LIST (ELECTRICAL)

QTY.	DESCRIPTION	MFG.	PART #
20	TERMINAL BLOCKS	WEIDMULLER	1020000000
2	NUMBERS 1-50	WEIDMULLER	0466760001
1	DIN RAIL	WEIDMULLER	0514500000
2	END STOPS	WEIDMULLER	1061200000
4	GROUND BLOCKS	WEIDMULLER	1010000000
1	TAG HOLDER	WEIDMULLER	292460
1	END PLATE	WEIDMULLER	1050000000



BULKHEAD LEGEND:

4T - 1/4" TUBING x 1/4" TUBING

6T - 3/8" TUBING x 3/8" TUBING

TUBING LEGEND:

1/4"O.D. x 0.035" WALL STAINLESS STEEL SEAMLESS TUBING

1/4"O.D. x 0.049" WALL STAINLESS STEEL SEAMLESS TUBING

3/8"O.D. x 0.035" WALL STAINLESS STEELSEAMLESS TUBING

REVISIONS

NO.	DESCRIPTION	DATE	BY
1	AS-BUILT - UPDATE DRAWING	9/29/10	LL

RSI Global
2063 PAXTON STREET
HARVEY, LA. 70058
(504) 340-1992

PROJECT:	LL	8/18/10
DESIGN:	LL	8/18/10
Q.A.:		
DRAFTER:	TH	8/18/10

ANADARKO

SINGLE WELL CONTROL PANEL
SCHEMATIC DRAWING

SCALE	JOB NO.	DWG. NO.	REV.
NONE	2010080501	2010080501-PH1	1

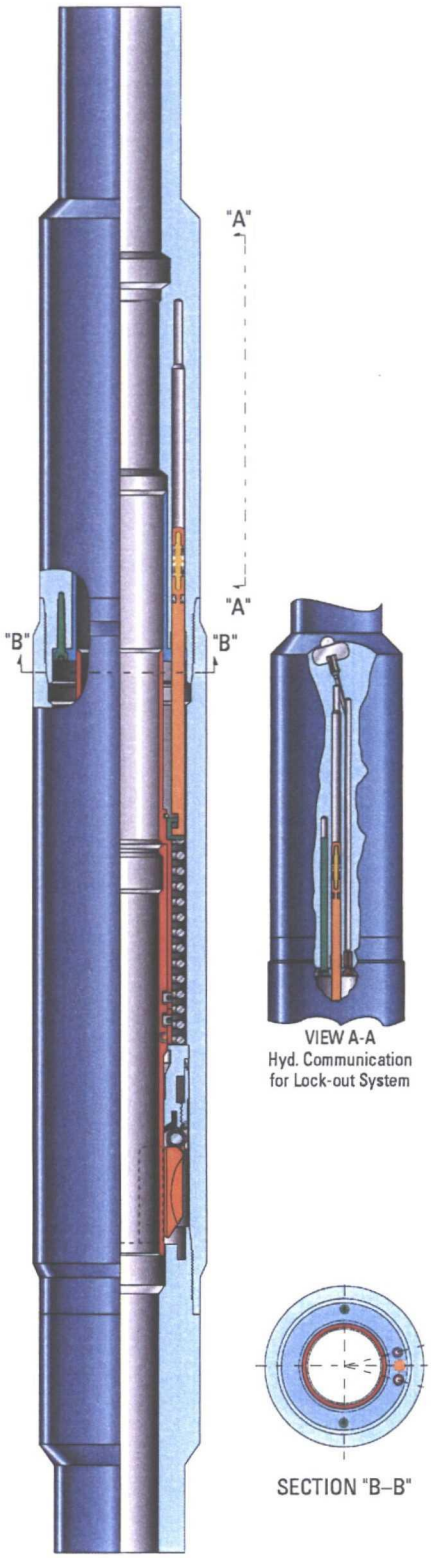
CAMCO TRM-4 SERIES SAFETY VALVES

INTRODUCTION

The Camco* TRM-4 tubing retrievable, subsurface safety valves are value engineered to provide exceptional versatility and reliability. Their short, compact design incorporates the best of our unsurpassed, field-proven technologies. The TRM Series features single non-elastomeric rod piston actuators, metal-to-metal body joints, a rugged, flapper closure mechanism, and a minimum number of critical seals to ensure maximum performance and durability. TRM-4 safety valves also feature secondary static seals in the full closed (metal-to-metal) position. The TRM Series are thus designed with rugged field proven features to satisfy life cycle requirements in harsh environments up to 5,000 psi.

FEATURES

- **Short, compact, cost effective design**
- **Minimum number of seals**
- **Proprietary metal seal body joint design**
- **Non-elastomeric hydraulic seals**
- **Static seal when operating piston is in the fully closed position**
- **Metal seal secondary valve communication plug**
- **Flapper lock-open with, or without, secondary communication activation**



VIEW A-A
Hyd. Communication
for Lock-out System

SECTION "B–B"

Schlumberger

CAMCO TRM-4 SERIES SAFETY VALVES

DESIGN OVERVIEW

All TRM-4 Series valves use a single rod piston with reliable, non-elastomeric sealing elements and a static, full-closed, metal-to-metal seal. For maximum reliability, every TRM-4 valve has only two body joints and utilizes our proprietary, premium threads to achieve a solid, metal-to-metal seal. The flapper mechanism in the TRM-4 also has full metal-to-metal sealing plus a secondary filled Teflon® soft seat and tested to a leakage acceptance criteria that is less than 0.25% of that allowed by API specifications.

APPLICATION

The TRM-4 is specifically deigned to exceed planned life cycle requirements in moderate to aggressive well environments with maximum pressures of 5,000 psi and maximum temperature (at the valve) of 300 °F. The TRM-4 can be used for production or injection applications. The design of the TRM-4 series allows a maximum of material and design options to cost-effectively fit specific applications and operating environments. TRM-4 valves are offered with a special surface treatment, ScaleGard™, that will minimize solids accumulations on coated internal surfaces of the valve, thus allowing proper valve operation in environments where surface accumulations may be present. TRM-4 valves are available with standard setting depths exceeding 2,000 feet. Deep set valve designs (5,000+ feet), reduced O. D. designs and self-equalizing valves are variations of the TRM Series that are also available.

OPERATION

The TRM-4 safety valves are a normally closed design. Opening is achieved by applying hydraulic pressure through a ¼" control line that extends from the safety valve through the wellhead to a surface control panel. Hydraulic pressure applied from the surface forces the rod piston downward, which in turn moves the flow tube downward. This downward movement of the flow tube compresses the valve's power spring while simultaneously rotating the flapper off seat into a fully open position. When the hydraulic control pressure is released, the power spring (+ well pressure valve depth) pushes the flow tube and rod piston upward to the closed position. The upward movement permits the hinged flapper to move into the flow stream, close against the flapper seat and shut in the flow from below the valve.

Lockout Procedure

In the event that the TRM-4 is needed to be locked open, a unique lockout mechanism enables a simple, one-trip, wireline operation to permanently lockout the valve and initiate secondary hydraulic communication. A lockout sleeve, located above the flow tube, is shifted downward with the use of a specially designed wireline shifting tool. This downward movement severs the shear plug, engages the lockout rod and permanently locks the safety valve open with hydraulic communication to the valve ID. The lock-out rod serves to prevent the valve from returning to a closed position. A secondary wireline valve can then be installed in the locked open TRM-4 valve. A second lockout option allows the valve to be locked open without activating secondary hydraulic communication.

**Mark of Schlumberger*

TRM Series Safety Valve Enhanced Functional Testing

Camco TRM Series Closure mechanism testing	The leak rate testing performed on the closure mechanism incorporates, and exceeds, the criteria set forth in industry standards such as API-14A and ISO 10432.The acceptance criteria used for flapper leak rate is zero. A zero leak rate is defines as "one bubble or less, every thirty (30) seconds", whereas industry standards allow up to five (5) SCFM* with a pressure differential of 200 and 1,200 psi
Internal Nitrogen Pressure Testing	Each TRM Series valve is required to pass an internal nitrogen pressure test of 100% of the valve's rated working pressure to verify integrity of the body joints and the operating piston's hydraulic system. This is not a requirement of industry standards such as API-14A or ISO 10432. The body joints of a TRM Series safety valve are not exposed to the hydraulic operating pressures required to operate the valve's rod piston. These pressures are typically higher than the valve's rated working pressure.
Operating Piston Hydraulic System Testing	Each TRM Series valve must pass a hydraulic system pressure hold test at a differential pressure of10,000 psi , regardless of the working pressure of the valve. Similar requirements of industry standards are that the hydraulic system be tested to "manufacturer's recommended hold open pressure" with an allowable pressure loss of 5%. The Camco test acceptance criteria is a maximum of a 10 psi loss (digitally recorded) over a 5 minute hold.
Body Joint Designs	All Camco TRM Series valve body joints are designed for compatibility with tubing connection torque requirements. Although not specifically related to functional testing, this consideration should be made when adopting safety valve specifications.
Testing During Valve Assembly	During each valve assembly, test procedures are applied which confirm that the operating piston up-stop provides a bubble-tight seal against working pressure with nitrogen prior to the installation of the dynamic piston seals. This is accomplished in a chamber housing fixture, prior to final assembly. The end result is verified piston up-stop seal integrity at the assembly stage for 100% of the TRM valves shipped.