



HEAVY MOVABLE  
STRUCTURES, INC.

# FIFTH BIENNIAL SYMPOSIUM

November 2nd - 4th, 1994

Holiday Inn Surfside  
Clearwater Beach, Florida

## SESSION WORKSHOP PRESENTATIONS

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### "100 TONS OF MOLTEN STEEL - A HEAVY MOVABLE STRUCTURE"

by MICHAEL HANLEY  
Circuit Engineering, Inc.

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## "100 Tons of Molten Steel - A Heavy Moveable Structure"

by  
Michael Hanley  
Circuit Engineering, Inc.

This project is located at the Florida Steel plant in Baldwin, Florida. Florida Steel produces 1500 tons per day of rebar and wire products for road and bridge construction at this location. The scope of the project was to rehabilitate a 20 year old hydraulic system on their 100 ton electric arc furnace/ladle.

Several similarities exist between this project and the application of hydraulics to moveable bridges. Aside from the obvious, that this is a massive structure (100 tons steel and 50 tons ladle), the ladle was built using an old moveable bridge design called "Scherzer" (see figure 1). In addition, the ladle is powered by two large hydraulic cylinders 14 inch bore by 130 inch stroke with 7" rods.

The special requirements of the project were also similar to moveable bridge hydraulic applications. Redundancy of components for reliable 24 hour operation, precise control of raise/lower function, and dependable hydraulic fluid were important criteria. Other requirements call for the

hydraulic system to operate other auxillary functions around the ladle and for the fluid to be fire resistant. Perhaps the most interesting feature is the "free fall and catch" function. This is performed when the ladle is near maximum raise during the pour operation. The operator raises the ladle slowly as he monitors the pour from the ladle. When the pour is near completion, the operator watches for signs of slag impurities to come out the spout. At the exact moment he spots the slag, he hits a "fast-back" control that sends the ladle into a free fall back to its rest position. The hydraulic system then provides the smooth deceleration and "catch" automatically.

Rehabilitation called for a complete new hydraulic system including new stainless piping. The old design used fixed displacement pumps with manual controls which did not provide the level of accuracy, speed, and control they were looking for. The only part reused from the old design were the existing hydraulic cylinders.

The power unit was fabricated in an L shaped design allowing flooded suction to two variable volume - pressure compensated piston pumps. Both pumps are connected to common pressure header supplying a steel manifold containing the necessary valves for all functions.

A separate fast back manifold is also connected to the supply header (Figure 4). The entire system was fabricated onto a common skid prepiped, tested, and printed.

The unique operation of the "Fast Back" feature allows them to dump the oil from two 14 inch bore hydraulic cylinders directly back to tank. This is accomplished by a 63mm logic poppet which is basically just a large pilot operated check valve. The flow of hydraulic fluid exceeds 800 gallons per minute for a couple of seconds until the ladle reaches a limit telling the hydraulics to go into the "Catch" mode. When this is initiated, the logic poppet is given a signal to close slowly and the raise/lower proportional valve is signaled to ramp down slowly over 5 seconds time. The logic poppet closes over a 1-2 second time frame causing the mass to decel considerably. At the same time the proportional valve is decelerating the rest of the load over a 3 - 5 second time. The result is a smooth catch that is adjustable, repeatable, and reliable.

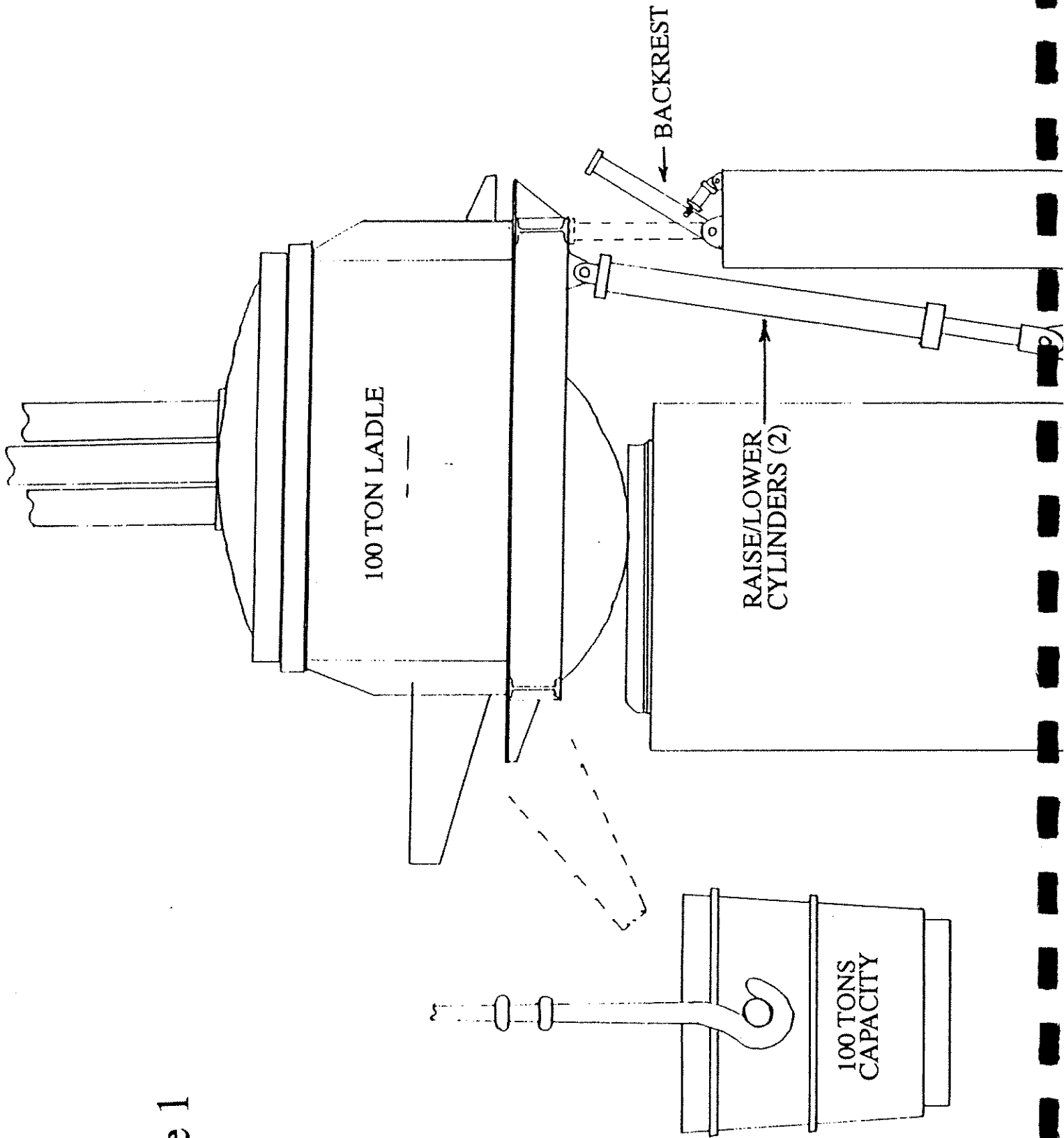


Figure 1

# Figure 2

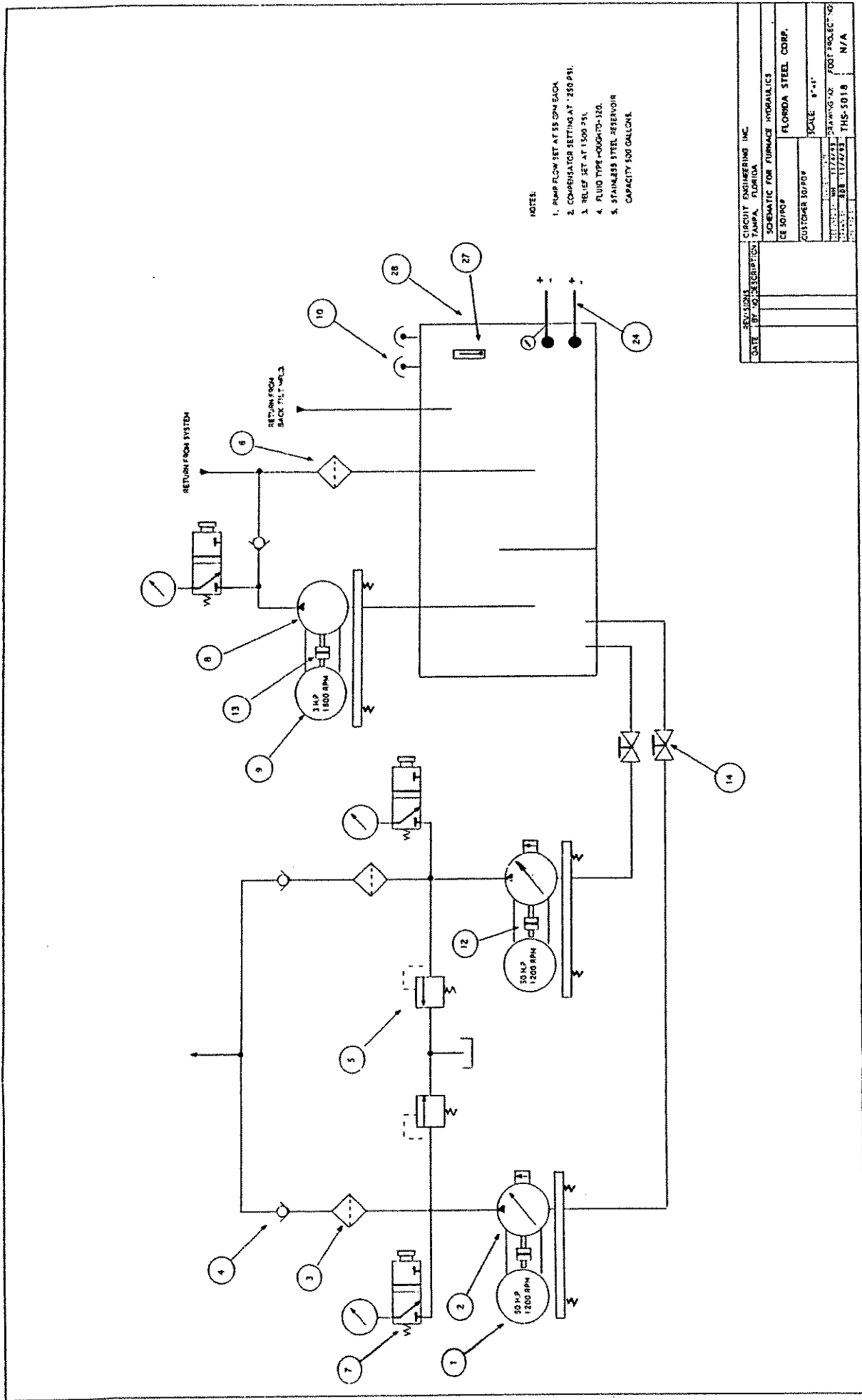
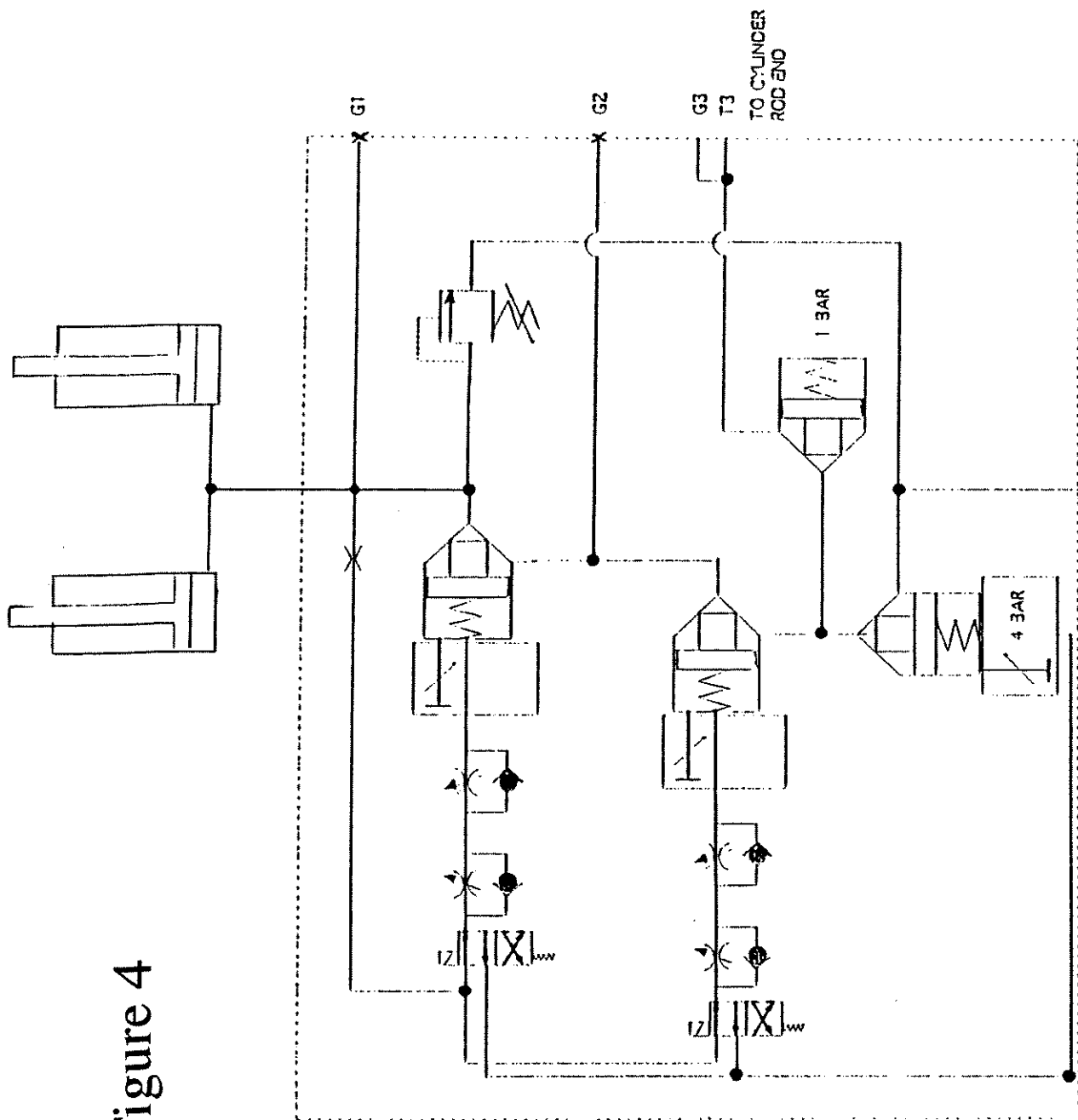
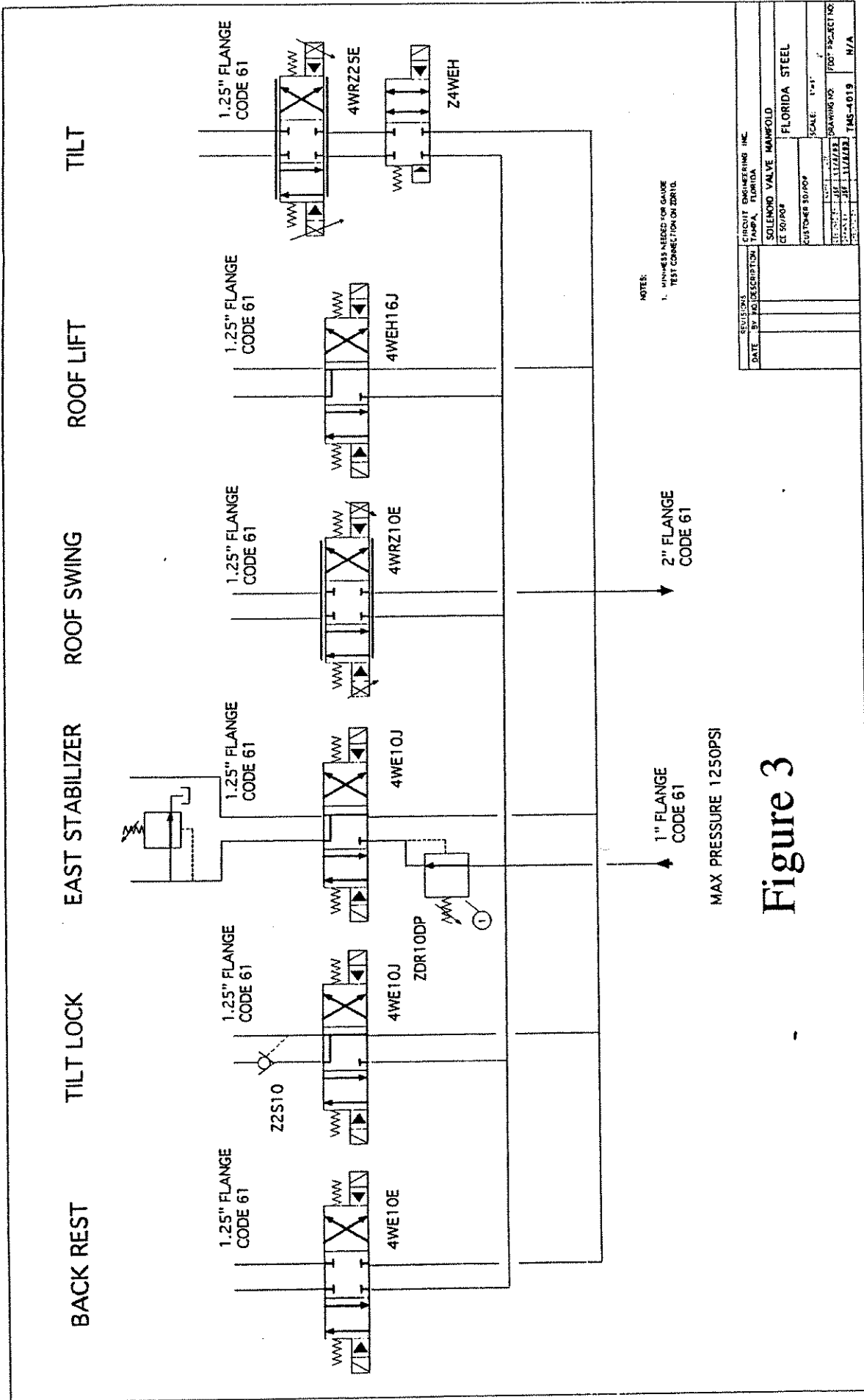


Figure 4





REVISIONS	CIRCUIT ENGINEERING INC.
DATE	TAMPA, FLORIDA
DESCRIPTION	SOLENOID VALVE MANIFOLD
DATE	FLORIDA STEEL
SCALE	1"=1"
DESIGNED BY	CE 50/P04
CHECKED BY	CUSTOMER 30/P04
DATE	
PROJECT NO.	TMS-4019
PROJECT	N/A

Figure 3