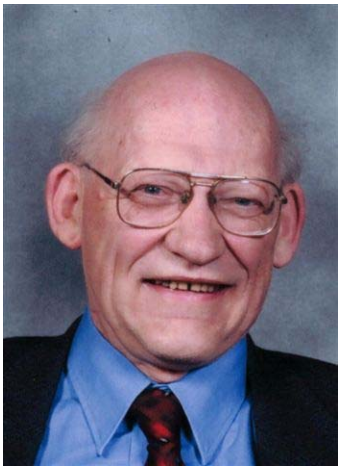
CONTROLLING EQUIPMENT



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SITE MAP. The links below are available for immediate viewing as web pages. The author appreciates feedback.

CONTROLLING EQUIPMENT

0 INTRODUCTION

1 CONTROLLING CENTRIFUGAL PUMPS
First published in *Hydrocarbon Processing*, July 1995

2 CONTROLLING POSITIVE DISPLACEMENT PUMPS
First published in *Hydrocarbon Processing*, May 1996

3 CONTROLLING SHELL and TUBE HEAT EXCHANGERS
First published in *Hydrocarbon Processing*, March 1998

4 CONTROLLING STEAM HEATERS
First published in *Hydrocarbon Processing*, November 1996

5 CONTROLLING FIRED HEATERS
First published in *Hydrocarbon Processing*, April 1997

6 CONTROLLING VESSELS and TANKS
First published in *Hydrocarbon Processing*, March 2000

MISCELLANEOUS

C Classics (Part 1), (Part 2), (Part 3)
An anthology of really old and mostly unattributed engineering lore.

D Dirty Pictures (Part 1), (Part 2)
A collection of photographs of 'incidents' that have been sent to me over the years.
These include 'Big Rock vs. Big Truck", "Big Truck vs. Little Truck",
"Plastic Bag vs. Storage Tank", "Atmosphere vs. Rail Car", "Local Hires in Alaska", and others.

F The Care and Feeding of Black Holes
First published in *Astronomy,* May 1995

L Connecting and Interpreting Limit Switches
First published in *Intech,* January 1993 as "Limit Switches Key to Valve Reliability"

M Michezo ya Mbao – Mankala in East Africa
First published in *Mila*, July 1972 as "The Game of Bao or Mankala in East Africa"

V The Compressor Monitoring Sketch
First published in *Intech, July 1990 as* "Getting the Picture with Compressor Monitoring"

Z Optimum Settings for Automatic Controllers
By J.G. Ziegler and N. B. Nichols, Rochester, N. Y.
First published "Transactions of the A. *S. M. E.*", November 1942,

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CONTROLLING EQUIPMENT, INTRODUCTION

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An industrial process consists of a number of unit operations interconnected to produce the desired result: conversion of feedstock into product. Equipment is chosen to carry out the required unit operations. It is the performance of these pieces of equipment that is controlled by the control system. For example, a pump is required to move a liquid from one point to another. It must be selected to be adequate for a range of operating conditions. The only way to accomplish this to is to select a pump large enough to handle the most demanding condition and then to trim it back to the specific requirements at every instant in time. It is the responsibility of the process control engineer to adapt the pump to produce the appropriate result. In other words, what is usually called 'process control' is for the most part actually equipment control.

EQUIPMENT CONTROL. Every type of equipment has a variety of options available for controlling it. A question I am frequently asked is, 'Which option is best?" The question may be more specific, "Why is this heat exchanger controlled on the steam inlet and the other controlled at the condensate outlet? Does it matter?"

It is the purpose of this series of articles to attempt to answer such questions. The simple answer is, "It all depends." Of all the possible control options some will simply not work and some will have undesirable side effects. Those that do work will have different secondary effects. Some examples:

A control mode that does not work at all:	Discharge throttling on a positive displacement pump.
A control mode with bad side effects:	Suction throttling on a centrifugal pump.
A control mode with special characteristics:	Bypass temperature control on a heat exchanger.

Once the 'bad' options are eliminated, the 'best' of the remaining options depends very much on the detailed characteristics of the control mode itself and on the special requirements of the process. In other words, there is no universal 'best'. It is the job of the process controls engineer to determine what is best for each individual case. The purpose of these articles is to outline the pros and cons of a variety of possible control modes for each type of equipment. However, the reader shall not, under any circumstances, expect to find the answer to the question, "Which is best?" What I am hoping to accomplish here is to introduce readers to a way of looking at things that will help them find the best solution to each unique case.

MEASUREMENT. Every type of equipment has its special measurement requirements. The guiding principle is to determine which is the actual value that is to be controlled and to install instrumentation that will measure that precise value. This is very much dependent on the specific purpose of the equipment. When this is not possible, adequate alternatives must be found. Such issues are addressed in these articles. They are not always self-evident.

EQUIPMENT PROTECTION. Every type of equipment has its particular weaknesses. These must be addressed by appropriate instrumentation. In some cases the strategy is to avoid trespassing into damaging regimes. In others it is possible to prevent damage from occurring.

SAFETY. Every type of equipment has its own dangers and safety concerns. These must be addressed by adequate controls. At the very least, instrumentation must be provided to detect and warn of unsafe conditions.

MINOR INSTRUMENTS. A good rule to follow when adding minor instruments to a Piping and Instrumentation Diagram (P&ID) is, "Everything that does something needs an instrument to indicate if it is actually happening." In other words, a heat exchanger should have thermometers at its various nozzles, a pump should have pressure gauges, a tank should have level indicators, etc. Each of the equipment control articles has a section indicating key instruments.

ADVANCED CONTROL. There are frequently simple optimization techniques available that will help to make the most of a given type of equipment. Descriptions of these are provided. Occasionally there are digressions into specific control techniques that have applications beyond those mentioned in the article.

REFERENCES. It is not the purpose of the reference section of these articles to provide a comprehensive bibliography of available material. Such a bibliography would be very large. A particular effort has been made to list significant codes and standards that have a bearing on each type of equipment. Some articles, such as the one on fired heaters, consist largely of a summary and explanation of the code requirements that apply.