Determine factors and Solve an equation

Prerequisite assumptions

- Understand basic math skills Addition, Subtraction, Multiplication, and Division
- Understand how to read a ruler

Notes to Self

- One thing I want to do during this lesson..teach how to set up an equation
- One thing I want to pay attention to the importance of following a wps
- One connection or idea to remember .... If you are struggling with the final results look at the values to see if they make sense.

Suggested Timeline

Duration	**Activity** (Indicate question number)	**Suggested Structure** (Indicate group, whole class Individual work)
5 minutes	Introduction –explain the value of the assignment. Handout the printed lesson & materials	Whole class
15 minutes	On the handout using the metric ruler indicate the wirefeed speeds to the nearest 10 in the x axis (vertical) draw a line across to the .035" line then down to the Y axis (amps)	Group work
15 minutes	Measure in mm from the x axis to the 200amp indication and also the two amperages marked off in the previous step	Group work
30 minutes	Setup the ratios and perform the calculations converting the two wirefeed speeds to amperage	Group work
45 minutes	Using the data, setup the heat energy formula and evaluate Kilo Joules.	Group work

SPECIFIC OBJECTIVES

By the end of this lesson, you should understand that

- In order to obtain accurate information you may need the aid of a ruler to interpret a graph
- In order to convert values the proper ratio must be setup
- An equation must be performed in the correct order

By the end of the lesson, you should be able to

- Interpret a wire burn-off chart
- Calculate the energy input of a weld

PROBLEM SITUATION 1: Measuring the values on the gragh

Students are given handouts in which they can scribe lines and take measuements.
From the information gathered they can then evaluate the energy heat input formula of a weld.

(1) Mark off the points on the x axis which are the given ipm values.

We expect a student may struggle with understanding that each millimeter on the ruler indicates 10 inches per minute of wire feed speed on the x axis. A student shown should notice The values increase as you go up vertically just as the increments on the ruler as shown in the handout.

(2) You are asked to scribe lines parallel to the axis in each direction from the intersection point on the .035" wfs line. A student may need to be shown how to mark off reference points to keep the lines parallel.

(3) Determine the amperages as they relate to the wirefeed speeds given.

A sudent needs to understand that any one of the amperage values listed on the graph can be used to setup the ratio and will give the same result
Just as the ratio remains the same when mixing oil in gas on a 2 cycle engine

(4) Use the data gathered and enter it into the heat energy input formula.

When looking at the heat input formula the units are expressed as a division The units of measurement need to match when you perform the calculation.
Min/sec 1/60
Kilojoules/ Joules 1/1000
Inches/foot 12/1

MAKING CONNECTIONS

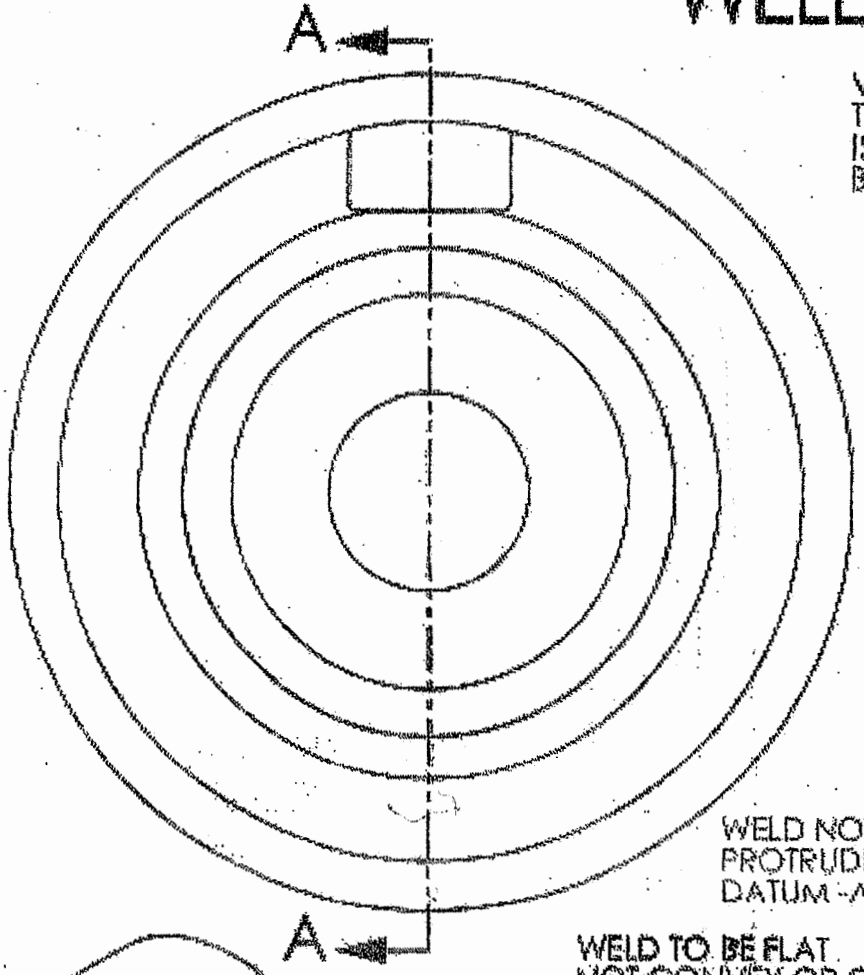
Record the important mathematical ideas from the discussion.

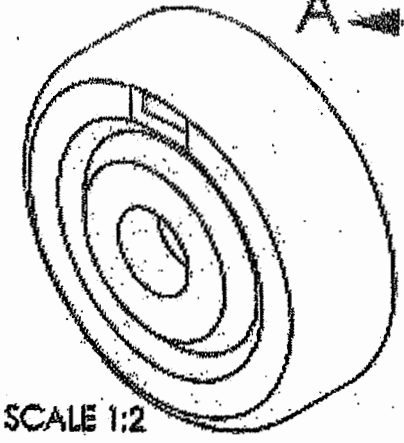
State the main idea of the lesson

Further Applications: The discussion can be expanded to include

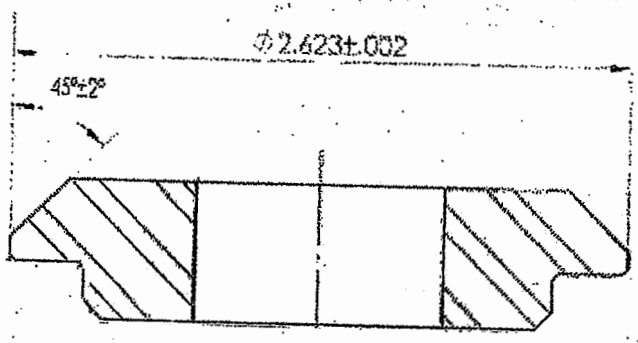
- **Establishing new weld parameters**
- **Deposition rates**
- **Calculating area and volume**
- **Weld cost**

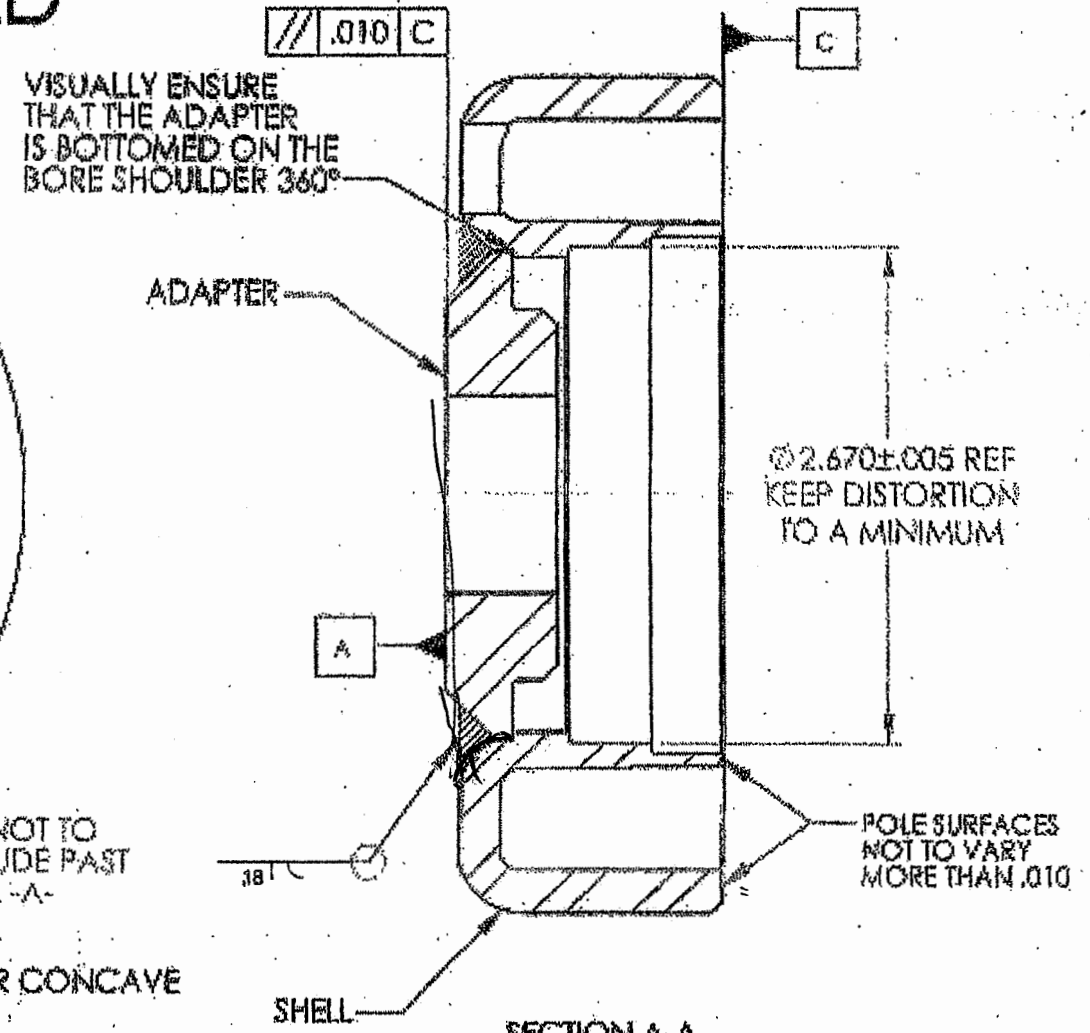
WELD





SCALE 1:2





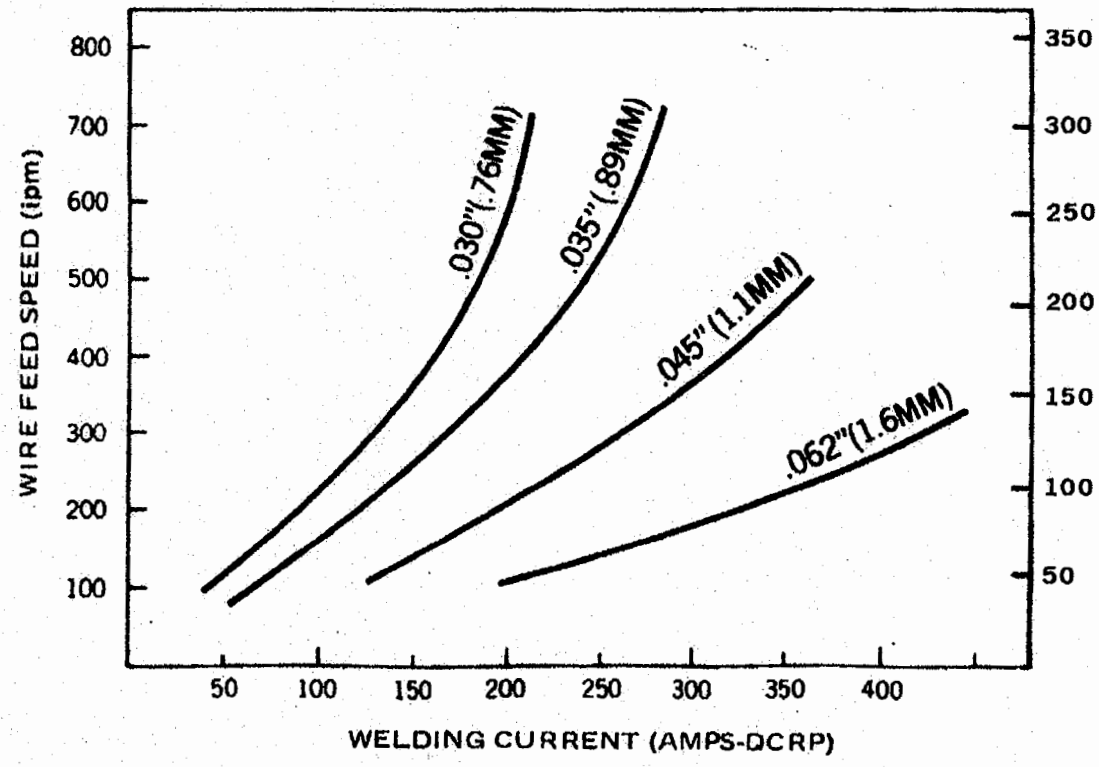
SECTION A-A

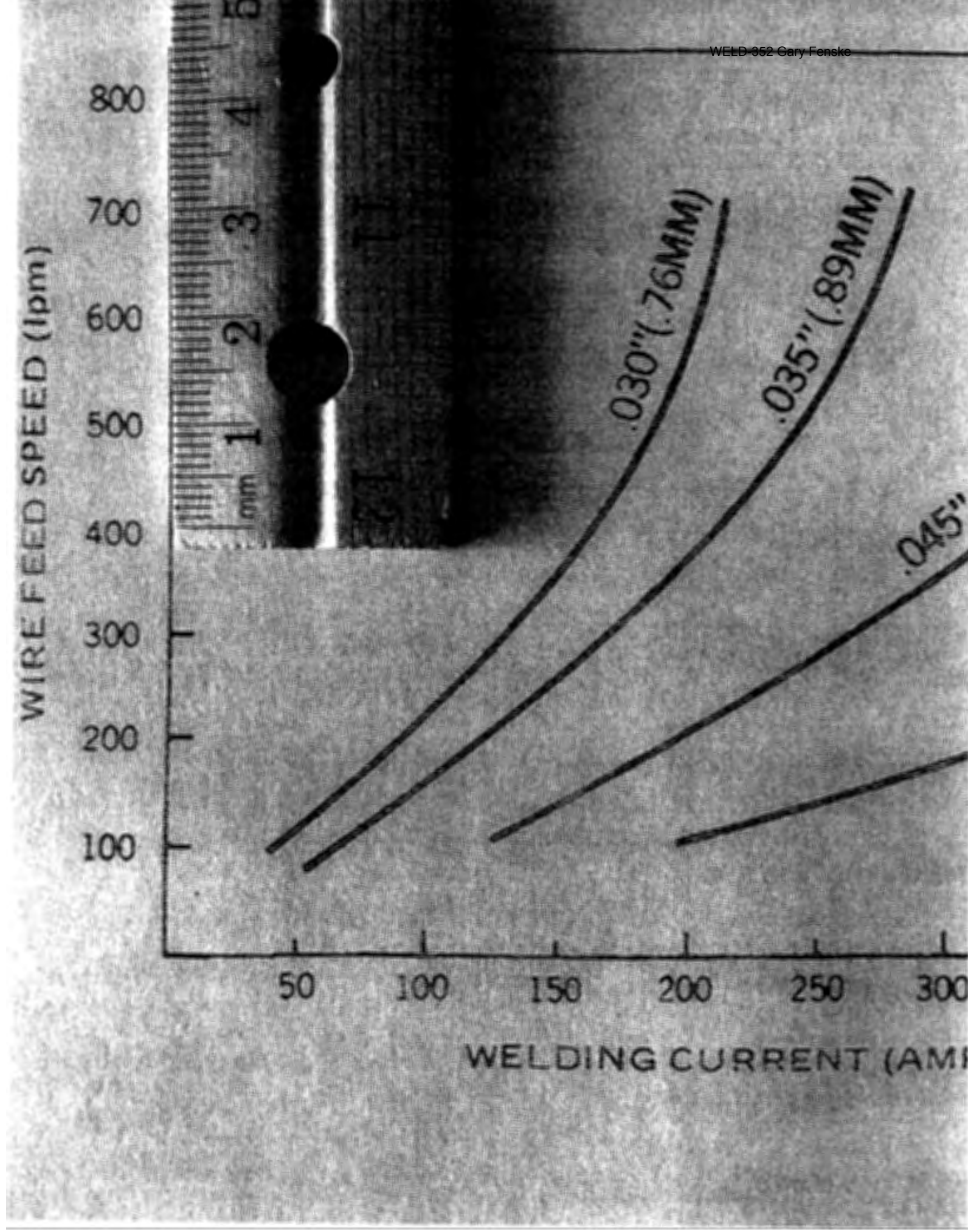
This part has been run in the past with the following weld parameters using .035" weld wire.
An operator at the welding robot made unapproved changes to the weld program. By going outside the parameters called out by the welding procedure specification (WPS) a rejection occurred.

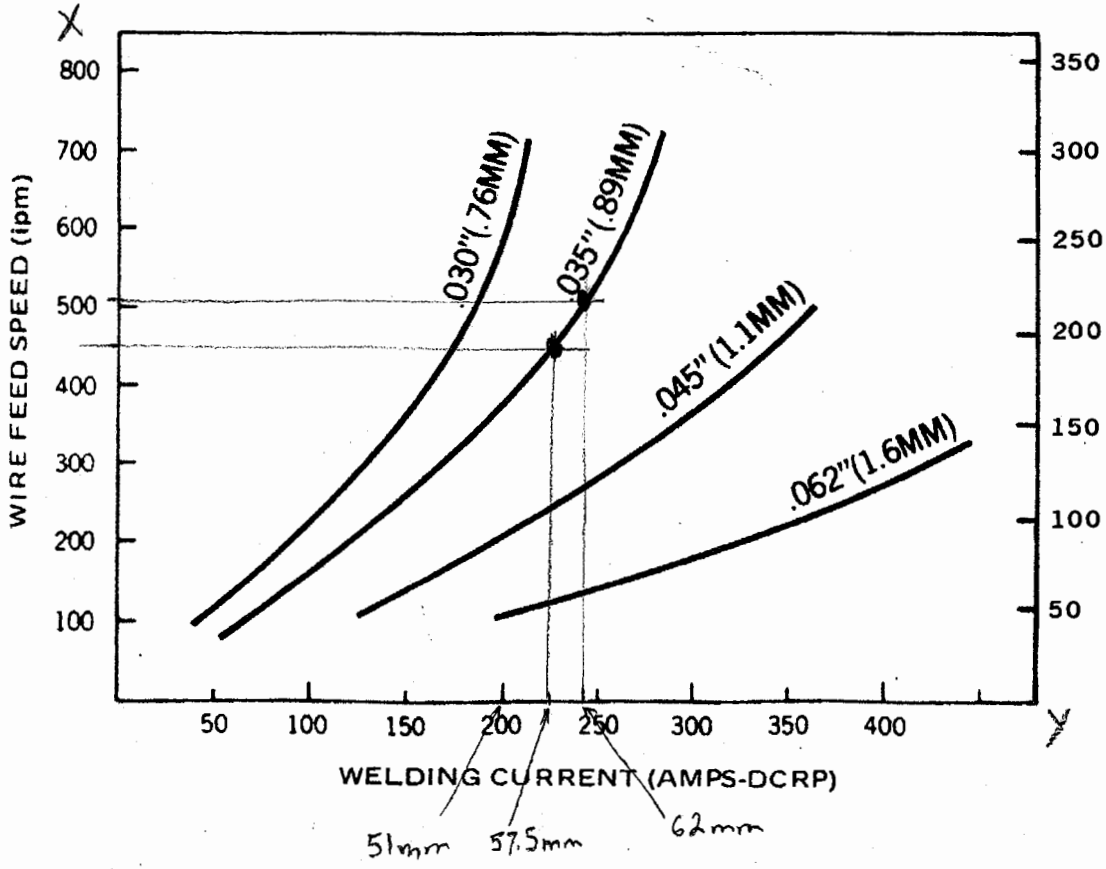
	volts	wfs	ipm
acceptable parameters	25	450	21
unacceptable parameters	27.6	510	20

The part is machined in steps.
First the bore diameter for the bearings is rough machined to a size smaller than the finished required size. After welding there is always some distortion to the part. This distortion will be removed as it is machined to the specified sizes on the final operation.
Using the unacceptable parameters weld distortion could not be machined out ands the parts were rejected.

In this assignment we will determine the heat input energy that caused the excessive distortion. The reason for the excessive distortion with the higher weld wire speed was due to a higher heat input.


WIRE FEED SPEED (ipm)
800
700
600
500
400
300
200
100
350
300
250
200
150
100
50
.030"(.76MM)
.035"(.89MM)
.045"(1.1MM)
.062"(1.6MM)
50
100
150
200
250
300
350
400
WELDING CURRENT (AMPS-DCRP)




X
Y
WIRE FEED SPEED (ipm)
800
700
600
500
400
300
200
100
350
300
250
200
150
100
50
.030"(.76MM)
.035"(.89MM)
.045"(1.1MM)
.062"(1.6MM)
50
100
150
200
250
300
350
400
WELDING CURRENT (AMPS-DCRP)
51mm
57.5mm
62mm

RATIO CALCULATIONS

Step1 setup formula values

51mm 57.5mm

X

200amp [ ] amps @ 450 ipm

51mm 62mm

X

200amp [ ] amps @ 510 ipm

Step2 cross multiply the known values

200x57.5=11500 amps @ 450 ipm

200x62=12400 amps @ 510 ipm

Step3 perform the division

11500/51=225.5 amps @ 450 ipm

12400/51=243 amps @ 510 ipm

51mm 57.5mm

X

200amp [226] amps @ 450 ipm

51mm 62mm

X

200amp [243] amps @ 510 ipm

Joules is a measure of energy in the form of heat

The equation for Heat input in Kilo Joules/inch is:

[(60 sec/min) x (amps) x (volts))] / [(kilojoule/1,000 joules)x(IPM)]= KJ/inch

Data	amps	volts	wfs	ipm
	226	25	450	21
	243	27.6	510	20

$$\frac{60 \times 226 \times 25/21}{1000}$$

60 x 226 x 25= 339000

339000/21= 16143

16143/1000=16.1 Kilojoules

$$\frac{60 \times 243 \times 27.6/20}{1000}$$

60 x 243 27.6= 402408

402408/20= 20120

20120/1000=20.1 Kilojoules