iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36261

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

Design and Development of Project Set Up for Gas Cutter for Straight Line Cutting

Nikhil Bhagwan Patil[1], Ajinkya Mukund Vashta[2], Tushar Ashok Dhokale[3], Deepak Manik Patil[4], Shahina Parvin Munir Momin[5], Appasaheb Tanaji Kadam[6]
[1, 2, 3, 4, 5]*B.tech Student* [6]*Assistant Professor, Department of mechanical engineering, NMCE, Peth,, Maharashtra, India*

Abstract: The Gas Profile cutting machine is one of the essential machine tool in the workshop, in this study it has seen that when the high temperature burning flame is in contact with the material particle, the material particle melts and the inter-molecular bonding gets break off to separate the material from each other. In this paper the design of various parts required in gas cutting machine is determined & calculations are interpreted. In this project we have tried to develop a low cost and simple mechanized arrangement for plasma coating on textile rollers.
Keywords: Gas cutter, Flames, Oxygen, Nozzle, Plasma, Mechanical linkages, cutting

I. INTRODUCTION

The Portable Multipurpose electromagnetic profile machine is one of the essential machine tool in the workshop. In general all fabrication and metal cutting carry out at the shop floor needs gas cutting for various operation. The Portable Multipurpose electromagnetic profile machine aimed at reducing time required in cutting intricate and curvature shaped profile shapes will be an important step towards minimizing the cycle time of each machine works. It will also lessen fatigue of operator, enhancing work conditions and accuracy at the shop floor. Gas cutting machines became a necessity within the world of metal fabrication. Hence, there are constant improvements and developments that take place in this field. In the last couple of decades itself consumers have shifted drastically from the traditional cutting methods that used to be quite inaccurate, time consuming, and lead to high quantity of wastage, to more efficient and more effective cutting methods like laser, oxyfuel, etc. With the use of such cutting solutions, businesses and companies have found a way to increase profitability, while reducing cost, time and wastage. Gas cutting machines have some advantages as compared to laser cutting machines. The machine is usually portable and doesn't take up an excessive amount of space. As compared to laser cutting machines, gas cutting machines can cut thicker sheets of steel or brass and other electrically-conductive metals like aluminium with fair accuracy.

Automatic Profile gas cutting machine have some features they are explained below

1) Profile gas cutting machine is a lightweight, portable yet robust shape cutting machine, which can be used on field job as well as in factories.
2) The machine is designed with pantograph type arms, which keeps the hinge points of all the arms parallel to the line of
3) The tracing roller and the torch, thus providing a direct line guiding system.
4) This is simplest and one of the most accurate magnetic tracing systems, which help in maintaining repeatability of the flame, cut parts.
5) Profile gas cutting machine can cut shapes like stars, hexagons, squares, rectangles, triangles, straight lines etc. and bevels up to 45 Degrees.
6) The basic system of the machine enables the torch to duplicate any intricate shape provided on a template on the machine.
7) The carriage arm consisting of a motor driven Electro Magnetic Tracing Head and a cutting torch travels round the template. 8. The tracing head can be moved in clockwise or anticlockwise direction by a selector switch.
8) Accurate & easy to operate.

A. Problem Statement

Problem related to conventional cutting process in industrial operations are Inability to process complex shapes.

1) It is difficult to apply constant flow of gas torch in cycle manually.
2) It lacks in case of precision accuracy and due to repetition of the work, the process causes boredom and fatigue to the worker.
3) Cost of automatic profile cutting machines is large.
4) Machines of this type having heavy weight.

So the main purpose of our project is to eliminate the above limitations.

In sheet industry, it's required to chop different profiles with desired shapes. Before, this was done manually by the worker which had drawbacks like; the process was time consuming which cause pending of the work. To remove above limitation in manual testing it had been necessary to develop mechanism which stands our expectations.

B. Objective

1) For straight line cutting uniform cutting rate is not possible by manual method.
2) Cost of automatic profile is more
3) To reduce time required to generate the profile.

C. Introduction to the System

1) Main frame
2) Guide bar
3) VFD Drive and motor
4) Gas cutting holder
5) Control panel
6) Lead screw.

II. THEORY

A. Working Principle

The working principle of machine is that, when the high temperature burning flame is brought in contact with the material particle, the material particle melts and the intermolecular bonding gets rupture to separate the material from each other. And the guiding mechanism to guide the gas tool holder smoothly to follow the straight line cut. The motor switch is made 'ON', the motor along with the gas holding bracket is guided to follow the required straight path of profile which is to be cut. Main switch installed on the body of the machine is started, prime mover i.e. motor shaft starts rotating.

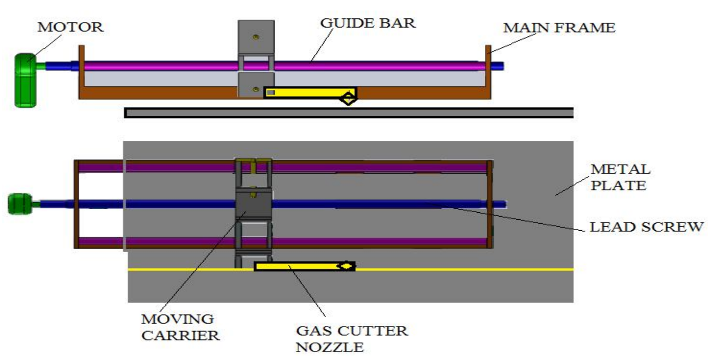

Fig.1. Proposed arrangement for GAS CUTTER MECHANISM.

The Gas Profile cutting machine is one of the important machine tool in the workshop, in this study it has seen that when the high temperature burning flame is brought in contact with the material particle, the material particle melts and the inter-molecular bonding gets break off to separate the material from each other.

In this paper we have tried to develop a low cost and simple mechanized arrangement for plasma coating on textile rollers.

In metal plate industry or in fabrication field, it is required to cut different profiles with desired shapes. In this project we have concentrated on straight line cutting. Normally this was done manually by the worker which had drawbacks explained below.

1) For straight line cutting uniform cutting rate is not possible by manual method.
2) The process was time consuming which lead to pending of the work.
3) Due to repetition of the work, the process caused boredom and fatigue to the worker.
4) It was difficult to apply consistent flow of gas torch in cycle manually.
5) Cost of automatic profile cutting machines is more .
6) Manual cutting profiles are not proper. Finishing and removal of sludge is required.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

III.CHOICE OF FUEL GAS

Basically, a mix of oxygen and a fuel gas (acetylene, propane, MAPP propylene or methane) is employed to preheat the metal to its 'ignition' temperature which is well below its freezing point. A jet of pure oxygen is then directed into the preheated area which burns through the spot and therefore the resulting molten metal and slag are removed by the high velocity oxygen stream. The cutting speed is primarily determined by the oxygen jet but because the outer fuel gas/oxygen flame determines the speed of preheating, the selection of fuel gas features important impact on the time taken to start the cutting operation. This is especially necessary if the designed cut begins by piercing. The choice of fuel gas is essentially made on cost, performance, simple use and whether it's a manual or mechanised operation. However, in making the selection it should be noted that during a typical application the value is formed from approximately:

1) 50% overheads
2) 30% handling labour
3) 18% cutting labour
4) 1-2% gas

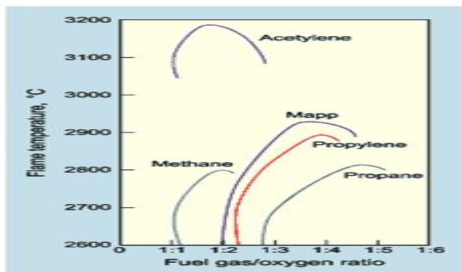

Fig.2. Flame temperature and the fuel gas to oxygen ratio

Consideration should, therefore, tend to the selection of fuel gas type and nozzle design to hurry up the initiation of the cutting operation. Labour costs are mostly reduced by reducing the pierce time and/or increasing the cutting speed. Usual flame temperatures and fuel gas to oxygen ratios are shown in Fig. above. Generally, fuel gases which generate a better flame temperature and need lower oxygen to fuel gas ratio, will speed up the cutting operation.

A. Acetylene

Acetylene produces the very best flame temperature of all the fuel gases and generates a highly focused flame. As the pierce time is approximately one third that achieved with propane, it should be used when the pierce time may be a significant proportion of the entire cutting time, as for, short cuts and multi-pierce cutting operations. The high temperature (maximum flame temperature in oxygen is 3160°C), highly focused flame makes the oxyacetylene process ideal for cutting thin sheets with minimum distortion and for bevel cutting. However, the high cost and low heat generation make it less suitable for general heating of huge plates.

B. Propane

Propane is available at low cost and can be available in bulk supplies. The flame temperature is comparatively less than for acetylene (the maximum flame temperature in oxygen is 2828°C compared with 3160°C for acetylene) which makes piercing much slower. However, it can tolerate a greater nozzle to workpiece distance which reduces the danger of molten metal splashing back onto the nozzle and causing a 'backfire'. Cutting speeds for oxy-propane and oxyacetylene are similar for similar nozzle designs. Advantages for propane are smooth cut edge, less slag adhesion and lower plate edge hardening due to the lower flame temperature. The heat affected zone is far wider than for oxyacetylene.

C. MAPP

MAPP gas, which may be a mixture of varied hydrocarbons, principally, methyl-acetylene and propadiene, produces a comparatively hot flame (2976°C). However, the lower calorific value of the inner cone compared with acetylene gives a rather slower pierce time. The gas is seen as an alternate to acetylene with greater tolerance to torch distance variation due to the more uniformly distributed heat between the inner and therefore the outer cones. For underwater cutting, only acetylene, hydrogen and MAPP have sufficiently high flame temperature. But as acetylene has a restricted outlet pressure, MAPP is the only gas other than hydrogen that can be used for cutting in deep water.

D. Propylene

Propylene may be a liquid petroleum gas (LPG) product and features a similar flame temperature to MAPP (2896°C compared to 2976°C for MAPP). It gives off a high heat release within the outer cone (72,000 kJ/m3) but, like propane, it's the disadvantage of getting a high stoichiometric oxygen requirement (oxygen to fuel gas ratio of roughly 3.7 to 1 by volume).

E. Methane

Methane has rock bottom flame temperature almost like propane and therefore the lowest heat content value of the commonly used fuel gases. Generally, natural gas is the slowest for piercing.

IV. COMPONENETS OF THE SYSTEM:

A. PMDC Motor

Fig.3 PMDC motor

In a dc stepper motor, an armature revolves inside the magnetic field. Basic working principle of DC motor is build on the fact that when a current carrying conductor is settled inside a magnetic field, there will be mechanical force applied on that conductor. All kinds of DC motors work on this principle only. Hence for constructing a dc motor it is essential to establish a magnetic field. The magnetic field is clearly established by means of magnet.

Advantages of static magnet DC Motor or PMDC Motor

PMDC motors have some advantages over other sorts of dc motors. They are:

1) No need of field excitation arrangement.
2) No input power in required for excitation which improves efficiency of dc motor.
3) No field winding hence space for field winding is saved which reduces the general size of the motor.
4) Cheaper and economical for many applications.

B. Plummer Block Bearing

A support usually refers to housing with an included anti-friction bearing. A support refers to any mounted bearing wherein the mounted shaft is during a parallel plane to the mounting surface, and perpendicular to the centre line of the mounting holes. A support may contain an impact with one among several sorts of rolling elements, including ball, cylindrical roller, spherical roller, tapered roller, or metallic or synthetic bushing. the sort of rolling element defines the sort of support . These differ from "plumber blocks" which are bearing housings supplied with none bearings and are usually meant for higher load ratings and a separately installed bearing.

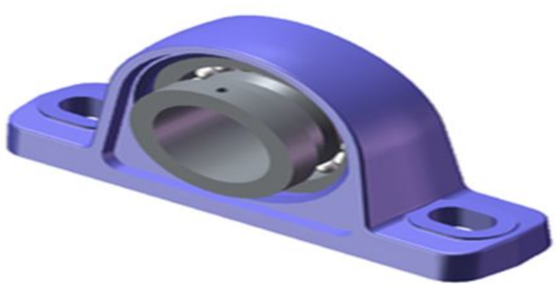

Fig.4 Block bearing

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

C. Nozzle

The primary function of the nozzle is to provide: a method for preheating the metal to its ignition temperature. A jet of oxygen to react with the material going to be cut and at a flow rate sufficient enough to blow away the slag; each torch should be fitted with the proper nozzle for the type of fuel gas. Nozzles can be of a one / two-piece design. The nozzle type will depend on:

1) Fuel gas
2) Manual or machine operation
3) Manufacturer's preference

Fig.5 Nozzle

D. Arduino Unit

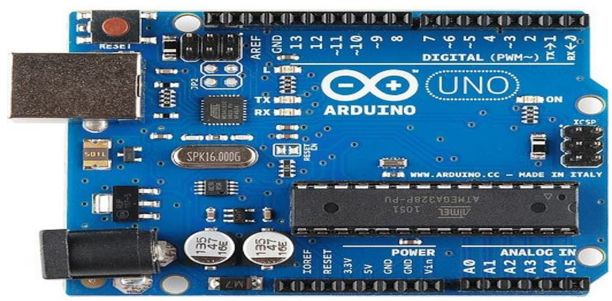

Fig. 6 Arduino Unit

The Arduino Uno is an open-source microcontroller board supported the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is given sets of digital and analog input/output (I/O) pins which will be assimilated to miscellaneous expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a kind B USB cable. These are often powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

E. Stepper Motor Driver

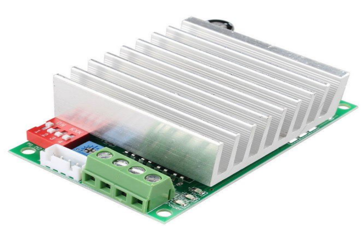

Fig.7 TB6600 motor driver

TB6600 Arduino Stepper Motor Driver is an convenient and professional stepper motor driver, which could control a two-phase stepping motor. It is compatible with Arduino and other microcontrollers which have an output of 5V digital pulse signal. This stepper motor driver has a broad range of power input, 9 to 42Volts DC power supply. And it is capable of output 4Amp peak current, which is sufficient for the most of stepper motors. The stepper driver assist speed and direction control.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

F. Limit Switch

Fig.8 Limit switch (3A)

A limit switch needs the physical contact of an object with the switch's actuator to form the contact turn (open/closed). As the object or target touches the operator of the switch, it is due course moves the actuator to the “limit” where the contacts change situation.

G. Material And Parts

Table 1. Material and Parts

Sr.No.	Name	Quantity
1	Thrust Bearing	2
2	Ball Bearing	2
3	Bolt(M20,M16,M10,M6,M4)	11
4	Nut(M6,M10,M16,M8,M20	14
5	Nozzle	1
6	Electric Motor With Gear Box	1
7	Arduino unit	1
8	Stepper motor driver	1
9	SMPS unit	1
10	Limit switch	1

H. Material Method:

Table 2. Methods for materials

Sr. No.	Components	Manufacturing Method
1	C-shape frame	Bending, Cutting, Drilling, Welding
2	Arm	Cutting, Drilling, Welding
3	Hollow Pipe	Cutting, Turning, facing
4	Counter Weight	, Drilling
5	Template	Gas Cutting
6	Main Column(rod)	Cutting ,facing .Turning ,Threading
7	Centre shaft	Cutting

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

V. DESIGN

A. Proposed Work

Design and development of project set up for gas cutter for straight line cutting

Specification of proposed project set up:

1) Type: Gas cutting
2) Power: - DC motor
3) Sliding mechanism: - Lead screw and nut arrangement.
4) Overall dimensions (Tentative):4feet length x width 1.5 feet.
5) Loading Capacity: up 15 kg
6) Speed capacity:- As per plate thickness

General Information

a) The machine consists of a measuring instruments such as guide bar and nut arrangement
b) Wall gas cutter weight = 10 kg
c) Load on screw we have considered = 15 kg
d) To avoid misalignment and proper wall chasing we have considered 30rpm speed of motor.

B. Selection of Motor

The load required to lift considered = 15 kg = 150N

The sprocket dia D = 100mm

So Maximum Torque T = Effort x Radius of wheel

Total torque on sprocket shaft = 150 x 50 = 7500 N-mm

P = 23.56 watt

By considering application and extra jerk and safe design prime mover power considered = 110 watt

Design of screw :-

Load on screw = load of structure + load due to jerk and shock load = 1500N

For design consideration W= 1500 x 1.5 = 2175 N

Axial load on screw = 2175 N

From design data book page no 5.68 selecting the nominal dia for screw is 20mm

Pitch = p=4mm

Assuming single start thread

now,

$$\tan \alpha = \frac{l}{\pi d_m}$$

$$\alpha = 4.04°$$

Assume coefficient of friction μ = 0.15

$\tan\phi = 0.15$

$\phi = 8.53$ degree

$F.S = \tau_{all} / \tau_{max}$

$F.S = 40 / 8.28$

$\tau = 4.83$ N/mm^2

Screw material is selected MS

Yield strength = 200 N/mm2

Ultimate tensile strength = 400 N/mm2

Young's modulus = 20,000 N/mm2

Considering factor of safety 2.5

As per max shear stress theory

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

C. Design of Drive Shaft.

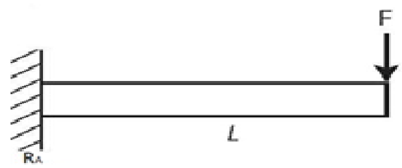

Fig.9 BMD

P = Load due to weight of grinder 10kg
T = Max Torque generated due to sprocket wheel. = 7500 N-mm
RA = Support reactions.
Motor speed N =30 rpm
For speed reduction the worm and worm gear is used. For our project we have used PMDC wiper motor .

As per Design data book shaft material is selected Carbon steel C40
σ = 145 N/mm2
As per ASME code
0.3 X Yield strength N/mm2
0.18 X ultimate strength N/mm2} whichever is smaller
0.3 x 330 = 99 N/mm2 ………………………………………….(a)
0.18 x 580 = 104 N/mm2 ……………………………………..(b)
From equation (a) & (b)
Allowable stress value will be 99 N/mm2
If key ways will provide to shaft then
τ = 99 x 0.75 = 74.25 N/mm2
Max torsional moment equation is given by
Where T = 7500 N-mm
By using above equation drive shaft dia d = 8.02 mm ……………….A

We know that,
Max bending moment equation is given by
We know,
$M = \Pi/32\ (d^3\sigma)$
P = 150 N
The sprocket dia D = 150mm
RA + RB = P
RA =150 ………………………………………………..I
The distance we have considered as per component fitment
L = 100 mm
Calculation of bending moment at loading point P,
BM at M = 150 x 100 = 15000 N-mm
we know,

$$M = \frac{\pi}{32} d^3 \sigma$$

σ = 145 N/ mm2 considering factor of safety = 4
By using above equation drive shaft dia d = 12.85mm ………………..B
From equation A and B we have selected the diameter of shaft = 20mm considering extra jerk and for safe design.

D. Manufacturing

The process of conversion of raw material into finished products using the three main resources as Man, machine and finished sub-components. Manufacturing is the term by which we transform resource inputs to create Useful goods and services as outputs. Manufacturing can also be said as an intentional act of producing something useful goods.

It's the phase after the design. The numerous processes using the following machines:-

1) Universal lathe
2) Milling machine
3) Grinding machine
4) Power saw
5) Drill machine
6) Electric arc welding machine

VI. RESULTS AND DISCUSSION

In this, our attempt is to design and development of project set up for gas cutter for straight line cutting. We have embraced a very careful approach; the total design work has been divided into two sections mainly.

A. System design.
B. Mechanical design.

System design mainly concern with the various physical constraints and ergonomics, space requirement, arrangement of various components on the main frame of machine. Control position of various controls, height of machine from ground, etc.

In mechanical design the components are categorized in two elements.

1) Design parts.
2) Parts to be purchased.

For design parts detailed design is done and dimensions are obtained and compared to next highest dimensions which are mostly available in market, this simplifies the assembly also as part production servicing work.

The various tolerances on work pieces are laid out in the manufacturing drawings. The part are to be purchased directly are specified and selected from standard catalogues.

VII. FUTURE SCOPE

In The proposed set up we have found some limitations and improvement points and as per feedback received from customer and experts we have listed some future scope in our project.

A. The PLC system we can add in the existing system for automatic control.
B. The production rate we have to increase by adding number of gas nozzles
C. The flexible length arrangement facility we have to add in the proposed set up.

VIII. CONCLUSION

In past decades industries are constantly growing and trying to gain more and more comfortless. Our attempt has been made to develop more and more modified technique with increasing the aesthetic and economic concern.

As an Engineer and having the knowledge ability to think and plan. But due to some time limits, and also due to lack of funds, we only have thought and put in the report the following future modifications.

A. As the thickness of the job increases time required for cutting also increases.
B. Surface finish obtained from cutting is good.
C. After manufacturing is completed no need of surface finish.
D. Less time required than manual gas cutting.
E. By installing the gear oil pump, it can be made hydraulic power operated.

IX. ACKNOWLEDGEMENT

We express our deep sense of gratitude to our respected and kind guide Prof. A.T.Kadam for their valuable help and guidance. We are thankful to them for encouragement they have given us in completing the project. We are also thankful to all the other faculty and staff members of our department for their cooperation help.

REFERENCES

[1] Jovana Ružić1, Miroljub Vilotijević1,2, Dušan , "PLASMA SPRAYING PROCESS AND CHARACTERISTICS OF DC-ARC PLASMA GUN" Metall. Mater.Eng Volume 18 (4) 2012 Page Number 273-282
[2] Ajit Behera " PROCESSING AND CHARACTERIZATION OF PLASMA SPRAY COATINGS OF INDUSTRIAL WASTE AND LOW GRADE ORE MINERAL ON METAL SUBSTRATES" Department of Metallurgical and Material Engineering ,Research Paper NIT ROURKELA INDIA May 2012
[3] Sulzer Metco "AN INTRODUTION TO THERMAL SPRAY" DIN EN 657; Thermal Spray – Begriffe,Einteilung; Beuth-Verlag, Berlin (1994)
[4] Amelia Sparavigna "PLASMA TREATMENT ADVANTAGES FOR TEXTILES" Dipartimento di Fisica, Politecnico di Torino Corso Duca Abruzzi 24, Torino, Italy Research Paper
[5] Nirav Siddhpura "REVIEW OF ANALYSIS OF TEXTILE SQUEEZING ROLLER" Vol-2 Issue-4 2016 IJARIIE-ISSN(O)-2395-4396 Nirav Siddhpura, Student ME, Mechanical Engineering, BVM Engg. College, Gujarat, India
[6] Manish Roy, K. K. Ray and G. Sundararajan, "EROSION-OXIDATION INTERACTION IN NI AND NI20CR ALLOY", Metallurgical and Materials Transactions A Vol. 32, No. 6, 1431-1451, 2001, DOI: 10.1007/s11661-001-0232-5
[7] Robert C. Tucker, "THERMAL SPRAY COATINGS" ASM Handbook, Volume 5: Surface Engineering C.M. Cotell, J.A. Sprague, and F.A. Smidt, Jr., editors, p 497-509 Copyright © 1994 ASM International® All rights reserved.