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The following summary was prepared by J. F. Gonzales (Sandia National Laboratories Albuquerque) from a report prepared by N. J. Schwentor dated March 19, 1980. This summary is to be presented at the Fall IMOG Machine Tool Subgroup Meeting that will be held on October 7 and October 8, 1980, at Sandia National Laboratories in Livermore, California.

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MASTER

INSERT TYPE MILLING CUTTER EVALUATION

The purpose of this test was to obtain data on the major manufacturers of Insert Type Milling Cutters. Each manufacturers' representative was contacted and informed of the pending test. They were told of the type of material to be machined and the parameters of the operation. The manufacturers were asked to supply us with a cutter and inserts; they recommended to meet our needs for machining 304 stainless steel as specified in the Machining Data Handbook. Only three manufacturers responded: Carboloy, Kennametal, and Valenite.

The material used in the machining test was 304 stainless steel, 2"x4"x8" long. Three pieces were cut from one piece of bar stock to assure uniformity of hardness and consistency of material composition. Each cutter made three cuts on one piece of steel, each cut was .125" deep. The surface feed and revolutions per minute were not the same for each cutter because of the variation of diameters and number of teeth in each cutter. This was necessary to assure equality of cutting conditions. Each cutter was tested for horsepower consumed during cuts, chip evacuation during cuts, cutter condition after cuts, insert condition after cuts, and finally the material was checked for surface finish.

The cutters that were tested were selected by the cutter manufacturers to meet, as closely as possible, the parameters of our test operation. The inserts were also selected by the manufacturers under the same conditions. Kennametal furnished a cutter model #KSSR-3SP4-15, three inch diameter, six tooth, positive axial rake, zero radial rake, fifteen degree lead angle, with insert #KC-810-SPG-422 TN coated. Carboloy (Futur-Mill) furnished a cutter model #Zp15L-0408, four inch diameter, eight tooth, positive axial rake, zero radial rake, fifteen degree lead angle, with insert #395-SRC-4342. Valenite furnished a cutter model #UMC-9204R, four inch diameter, six tooth, positive axial rake, positive radial rake, fifteen degree lead angle, with insert #NIN-SPE-63E TN coated.

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Each cutter was sent to the Mechanical Inspection Section to be inspected for run out of cutter seats to arbor hole, seat height variation without insert, and cutter height variation with insert. The results were as follows:

Kennametal - Runout = .0009"
Seat height variation w/o insert = .0045"
Cutter height variation with insert = .0017"

Carboloy - Runout = .0011"
Seat height variation w/o insert = .0009"
Cutter height variation with insert = .0016"

Valenite - Runout = .0010"
Seat height variation w/o insert = N/A.
Cutter height variation with insert = .0009"

The equipment used in the test consisted of: one (1) Valeron Power Monitor Model #720-002 for measuring horsepower; one (1) Hewlett Packard Digital Recorder Model #5050A for print-out of horsepower used during each second of machining; one (1) Hewlett Packard D.C. Multi Function Unit Model #3444 for visual readout of horsepower consumed during each cut; and, one (1) Kearney and Trecker Model #25HP-4CK vertical milling machine with a #50 spindle adapter and a 25 horsepower D.C. drive spindle motor.

The results were as follows:

Kennametal Model #KSSR-3-SP4-15 cutter was run at 360 surface feet per minute, 480 RPM, feed rate of 26 IPM, and chip load of .009" per tooth. Test results:

Horsepower Used Cut #1 = 9.753 max.
Horsepower Used Cut #2 = 13.773 max.
Horsepower Used Cut #3 = 17.443 max.

(see attached graph for second by second recording of horsepower consumption during each cut). Chip evacuation: very poor, strong evidence of chip re-cutting. Cutter condition: after three cuts, cutter showed excessive marring on clearance surfaces and insert holding devices. This cutter would require a great deal of maintenance to keep it operational. Insert condition: inserts were badly chipped and broken down after only three cuts. Material condition: after the third cut, the surface finish of the 304 stainless steel was 230 microinches. This is a very rough finish.

Carboloy (Futur-Mill) Model #ZP15L-0408 cutter was run at 360 surface feet per minute, 358 RPM, feed rate of 22 IPM, and chip load of .009" per tooth. Test results:

Horsepower Used Cut #1 = 8.603 max.
Horsepower Used Cut #2 = 10.343 max.
Horsepower Used Cut #3 = 12.513 max.

(see attached graph for second by second recording of horsepower consumption during each cut). Chip evacuation: very poor, strong evidence of chip re-cutting. Cutter condition: after three cuts, cutter showed marring on clearance surfaces and insert holding devices. This cutter would require an average or above average amount of maintenance to keep it operational. Insert condition: inserts slightly chipped, workpiece material welded to insert on flattened wiper area. General condition of inserts was very poor after only three cuts. Material condition: after the third cut, the surface finish of the 304 stainless steel was 64 microinches. Moderately fine finish.

Valenite Model #VMC-9204R cutter was run at 360 surface feet per minute, 358 RPM, feed rate of 18.5 IPM, and chip load of .009" per tooth. Test results:

Horsepower Used Cut #1 = 7.98 max.
Horsepower Used Cut #2 = 8.01 max.
Horsepower Used Cut #3 = 7.903 max.

(see attached graph for second by second recording of horsepower consumption during each cut). Chip evacuation: excellent, no evidence of chip re-cutting. Cutter condition: after three cuts, cutter showed no marring in any areas, cutter would require little or no maintenance to remain operational. Insert condition: inserts in excellent condition, no chipping, welding or wear evident after three cuts. Material condition: after the third cut, the surface finish of the 304 stainless steel was measured at 28 microinches. This is a very smooth finish.

Summary conclusion and cutter recommendation:

It was our intention, with these tests, to determine the best cutter for our use. Each cutter was exposed to the exact same conditions, varying only where the cutter parameters dictated, to assure equality. The test results show that the Valenite cutter and inserts would require the least amount of maintenance, the greatest amount of wear life, and the best finishes. This cutter also required the least amount of horsepower in each cut. This is also advantageous from a power consumption outlook. The Valenite used a maximum of 8.01 horsepower, which is 5,968.48 watts of power, where the Kennametal cutter used a maximum of 17.443 horsepower, which is 13,012.48 watts of power consumed. This is almost two times the energy consumption.

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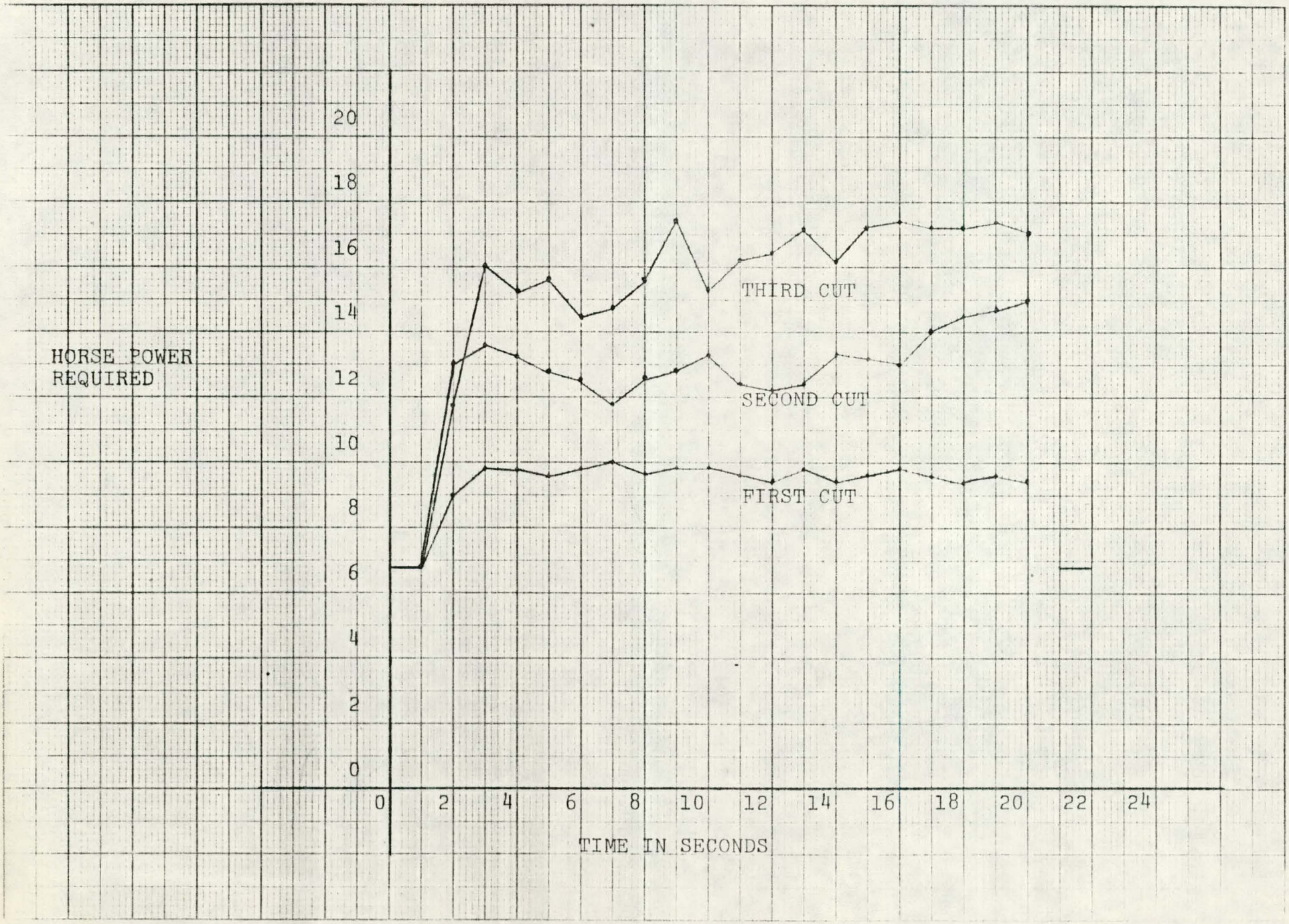
KENNAMETAL



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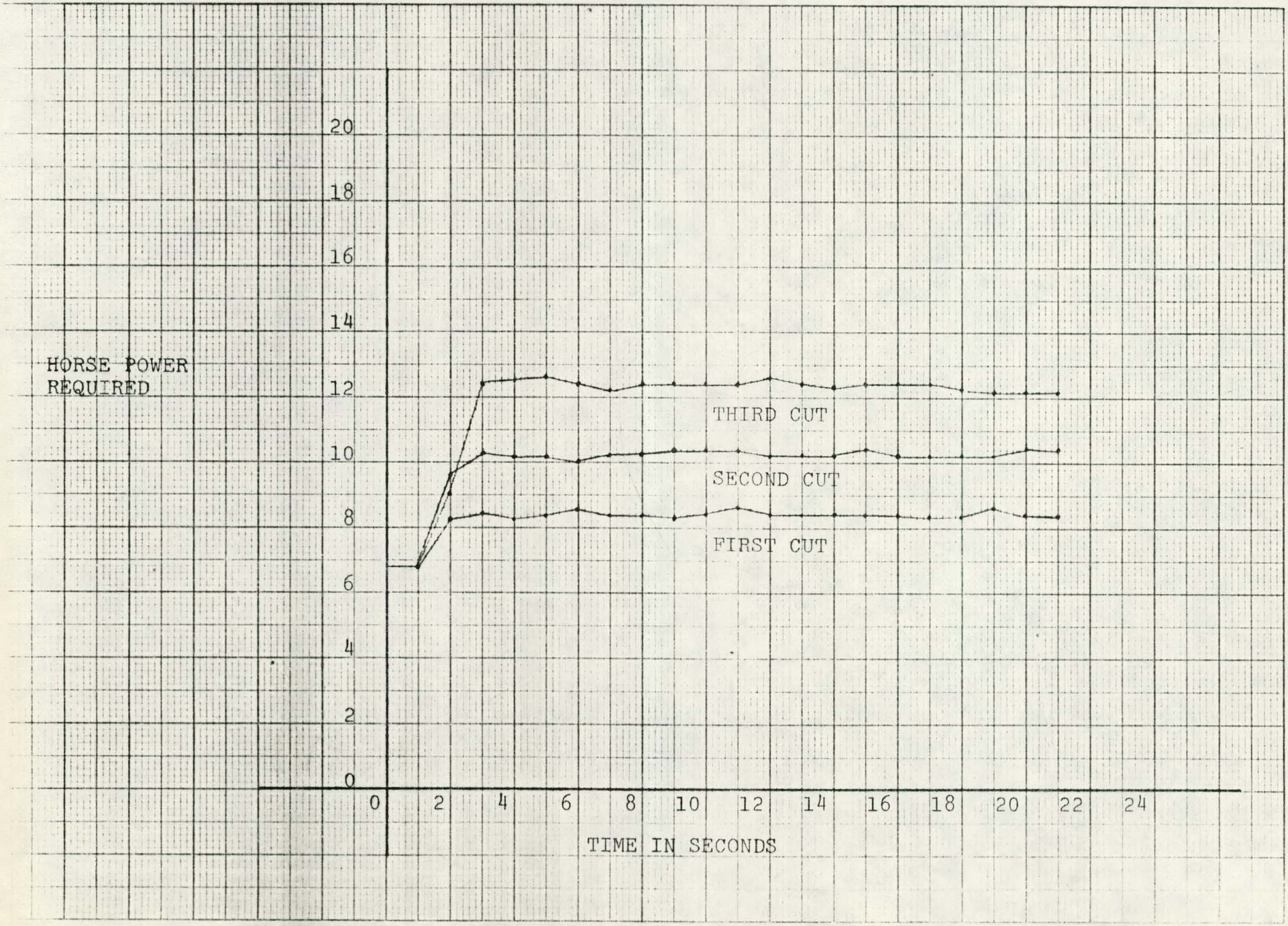
CARBOLOY



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VALENITE