VOLUME DETERMINATION

L. W. Black

QUALITY DIVISION

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FINAL REPORT

MASIL

Process Development
Endeavor No. 219

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Panteco Plant

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806-335-1581

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ABSTRACT

A concept for determination of parts volume, particularly high explosives, was investigated. The system involved placement of an item of known volume within an enclosed vessel. A piston arrangement connected to the vessel was withdrawn to create a negative pressure. The position of the piston is noted and the procedure repeated with the chamber empty and the piston location is noted with the same inside pressure. The difference in piston location is then related to part volume.

DISCUSSION

A prototype system was built with a 152-mm diameter piston having a 200-mm stroke. The measurement system consisted of a Vernac Scale linear measuring device and a Hamilton Standard 0-140 kPa pressure transducer. Free volume of the chamber was approximately 10,000 cc. Fig. 1 gives a schematic of the operation of the apparatus. An item of known volume is placed within the chamber. The piston is withdrawn to create a negative pressure. The position of the piston is noted. This procedure is repeated with the chamber empty and with the unknown volume item within the chamber. A simple relationship between the piston position determines the unknown volume.

Tests of this system indicated the precision was inadequate for large high explosive parts (5000 to 8000 cc). About 1 part in 700 accuracy

was achieved. However, the requirements are 1 part in 5000.

This method may be feasible for volume determination of much smaller parts and is currently being evaluated. There is a requirement to determine volume of ~ 2 cc of high explosives added to a 25-cc metal part. It is proposed to fabricate a container for the metal part to reduce the free volume of residual air to less than 10 cc. Instrumentation will include a small capacity Volumetrics Micrometer and the Hamilton Standard pressure transducer used in the prototype system.

CONCLUSION

Attempts to determine large volumes (1000 to 10,000 cc) by this method will not be further pursued. However, there remains a potential that very small volume unknowns can be determined.

$$V = \frac{10,000 (A - A_2)}{A - A_1} \text{ cc}$$

Where:

- V = Volume of Unknown
- A = Scale Reading with Chamber Empty
- A₁ = Scale Reading with Known (10,000 cc) Volume in Chamber
- A₂ = Scale Reading with Unknown Volume in Chamber

Fig. 1. Volume Determination by Pressure Differential