

## Low Pressure Injection Molded Tungsten Carbide

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As an engineer or end item user, have there been times that you have had a severe wear problem? You know that the problem could easily be solved by using tungsten carbide, but the geometry of the part is such that pressing, preform, or extruding can not be used.

Low Pressure Injection Molded (LPM) Carbide from Retco Tool Co., Inc can be your solution. The near-net shape capabilities of injection molding are well known in the plastic, ceramics and metal industries but until the last few years tungsten carbide parts have been thought to be “undo-able.” Near-net shape LPM carbide parts are here. The geometric shapes that can be addressed with LPM, but not with other process’ are almost limitless.

Retco is a fully integrated facility that has been in business for 40 years. Five years ago, we established our own low pressure injection molding department to provide complex geometric shapes for use in the wear parts industry. The synergy from powder to molding to final fabrication is a valuable tool in the development of new products specified by our customers.

The savings to Retco’s customer due to the lower cost start-up and tooling costs has created a healthy partnership. Retco’s ability in tungsten carbide grade development has led to the development of tungsten carbide wear grades with a Rockwell A hardness of <95.0 using Ultra grained powder.

LPM is ideal for the short run of less than a 1000 parts and can be tooled up for long runs.

### The Process

The process consists of placing Tungsten Carbide grade powder with an organic binder in a double planetary mixer. The powder and binder are then mixed until it is a homogenous plastisol. The parts are then molded in aluminum tooling, 90% of which is built in-house. The control of the green density when compounding the powder is critical. Tungsten Carbide can shrink from 20 – 30% when sintered and the tooling is built with appropriate shrinkage allowances built in. We control the green density to insure that all tolerances are met.

The part, after molding, is inspected before being dewaxed. At this point in the process the part can be reverted and re-melted for use as another part if any deficiencies are found.

The parts are then placed in a organic media and thermally de-waxed. By using an organic binder and organic de-binding media, we do not have any EPA

problems. The media and binder can both be disposed of in the local landfill. The parts are then sintered in a vacuum furnace. After sintering, the parts are evaluated metallurgically. For critical porosity call-outs, the parts are then Hot Isostatic Pressed.

### The Material

Retco currently produces parts using a 4½% Co ultra grain material, a 4½% Co sub-micron material, a 6% Co sub-micron material and a 12% Co coarse grain material. (see table 1)

Grade	RX4U	RX4s	RX6	RX12
% WC	95 – 96	95 – 96	94 – 95	88 – 89
% Co	4 – 5	4 – 5	5.5 – 6.5	11.5 – 12.5
Density g/cm <sup>3</sup>	15.10	15.10	14.90	14.30
Hardness R <sub>a</sub>	>95	94 – 94.5	93.0	87.5
Porosity	A 02 B 00 C 00	A 02 B 00 C 00	A 02 B 00 C 00	A 02 B 00 C 00

Table 1: Retco Wear Grades

### The Product

Part geometry is a major issue when converting a wear application to carbide. LPM allows the engineer or End item user to use his imagination. Retco stands ready to demonstrate the feasibility of your geometric design. Some examples of different geometric shapes are; nozzles with an angled exit, rectangular nozzle, interior dimension ( I.D), with a venturi , ears or locating lugs on an outer dimension( O.D.), countersinks or undercuts already molded in that don't have to be ground. A major tooling advantage can be obtained when a part has the same outer dimensions but has several I.D. details, say 0.015-0.250 inch. The same mold body can be used and core rods built for the different I.D.s as they are required. Irregular shaped parts that can't be pressed can be injection molded.

The smallest part currently being manufactured is a 0.300 inch (7.62 mm) long nozzle which has a 0.011 inch (0.28 mm) venturi in the I.D. This part weighs less than a gram. The largest part currently in production is a feeder tube that is 7 inches (176 mm) long with a 1.25 inch (31.75 mm) O.D., a 0.750 inch (19 mm) I.D.. This tube has a 5° angle about ¼ of the way up from the entrance and a 1.0 inch radius in the I.D at the exit end to divert the flow 90° to exit the tube. This part weighs 550 grams.

See figure 1 for an example of various LPM carbide parts.

## Dimensions

Retco has yet to determine what the maximum dimensions suitable for LPM are. We have made complex nozzles with a 0.006 inch (0.15 mm to 0.750 inch (19 mm) I.D.s. We are currently producing nozzles that have a 90° change of

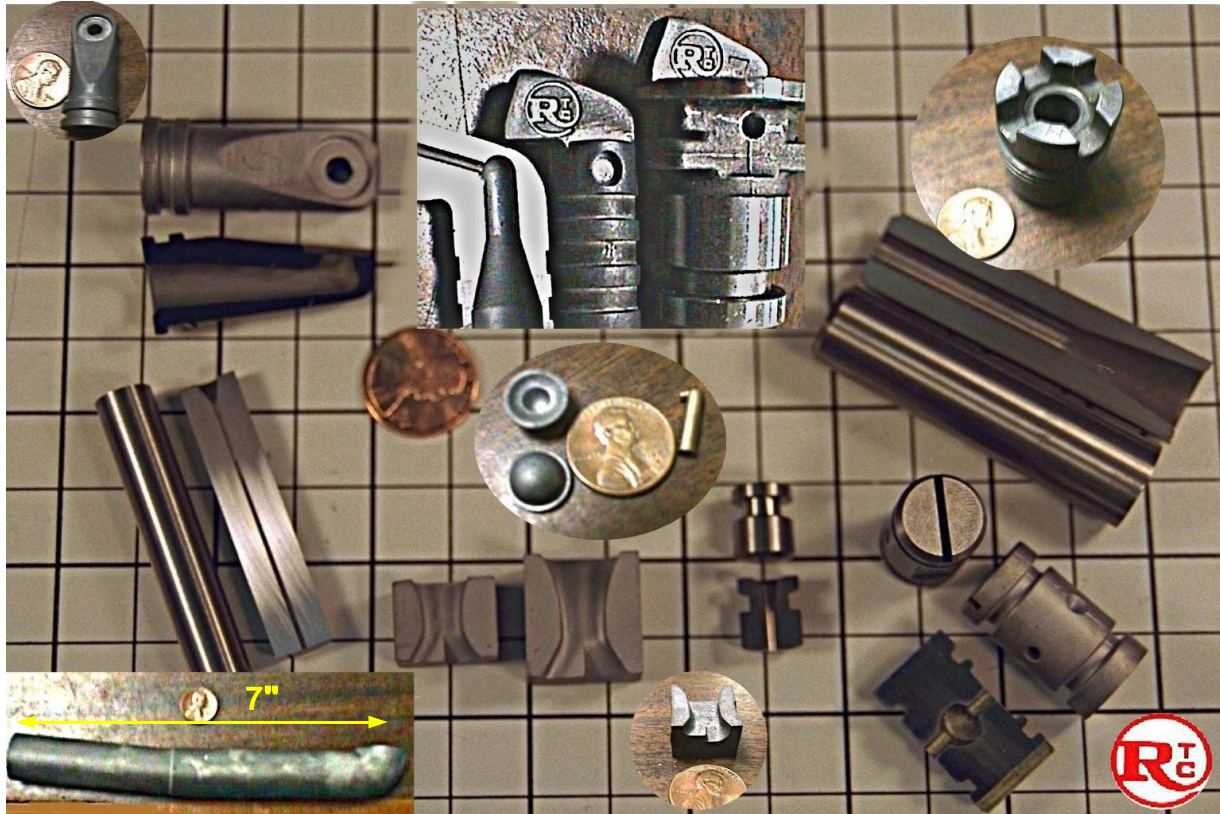


Figure 1: LPM geometry currently in production

direction on the exit end.

## Tolerances

Retco as-molded tolerances are a function of actual dimension. Dimensions up to 0.100 inch (2.54 mm) are  $\pm 0.002$  inch (0.05 mm). Every dimension above 0.100 inch are currently being held to  $\pm 0.005$  per inch (0.127 mm). We can work with the customer to meet his desired dimension or show why an alternative dimension would work.

## **Costs**

When the part geometry is such that you require a near net shape to reduce fabrication costs, then LPM is the process you should use. The LPM advantage in the myriad of geometry required is a plus in trying to solve your wear problems . As a rule, carbide will wear 10 times longer than steel. A near net shape tungsten carbide part can reduce your down time and maintenance costs.

## **The Company**

Retco has been in the cutting tool business for 40 years and in 1968 established their wear parts fabrication division. In 1994, the low pressure molding department was added to the wear parts division. We provide cutting tool sales and wear parts to the Aerospace, Petroleum, Electronics, Mining, Optical, Dental and General Manufacturing Industries. We produce geometry that can not be produced by any other form of manufacturing, especially creative I.D.s. By producing near net shape parts tighter tolerances can be held for efficiency in final operations.

Our Mission is to create long term partnerships with our customers based on Honesty, Integrity, Quality, Reliability and Service. We strive to provide materials and products that are the leading edge of the Metal Industry, insure that meeting or exceeding your specific need is paramount, Analyze, Ask Questions, and Communicate with our customers, apply the most advanced Quality Assurance and Non-Destructive Testing Techniques and capabilities and provide unparalleled Customer Service.

Our Staff is fully trained with 50 years of quality service behind them.



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