

Radial Surface Grinding



Huffman Corporation offers multi-axis, superabrasive grinders that are used extensively in the turbine component manufacturing and repair markets. Huffman machines are especially productive on components like **VANE AND NOZZLE SEGMENTS, AND SHROUD, SEAL AND DUCT SEGMENTS.**

These components are similar in that they have a complex cross-section consisting of many individual surfaces, including grooves that are then “swept” along an arc around an engine centerline.

AN AERO-ENGINE VANE SEGMENT EXAMPLE

Five grinding wheels are mounted on a single wheel arbor. Three fixtures are mounted on the rotary work table. The result: 24 surfaces are ground - leading edge, trailing edge and mate face surfaces - in a single grinding cycle. Total grinding time is 15 minutes.

The proper application of superabrasive wheel technology, fixturing, grinding fluids, and programming on a precise, reliable Huffman machine enable single part flow, replacing batch flow on large rotary grinders.

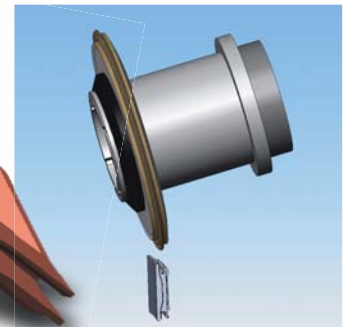
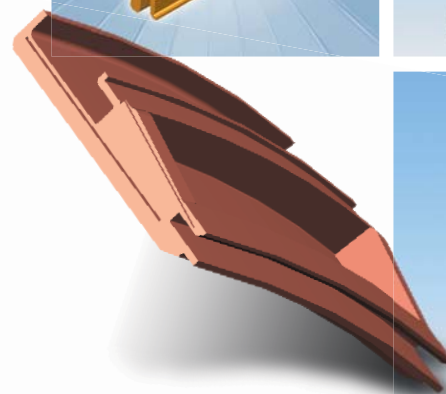
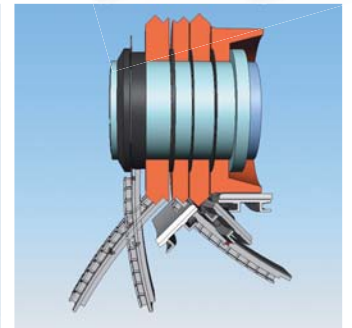
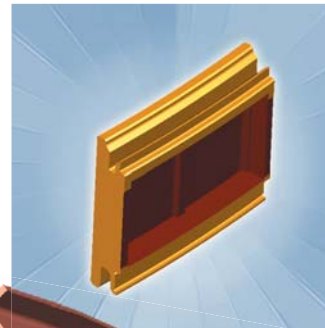
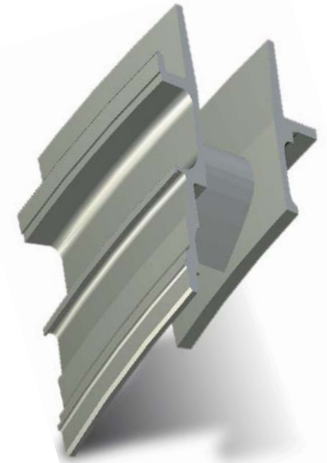
A SHROUD SEGMENT EXAMPLE

Again replacing several very large rotary grinders, Huffman grinds a complete part in one cycle. Four grinding wheels are mounted on a single wheel arbor. A single part is fixtured on the face of the rotary work head. Five complex surfaces including the I.D., forward edge groove, aft edge groove, and two “ship lap” surfaces are ground complete. Cycle time: 9 minutes.

Combining operations on a Huffman machine collapsed throughput time, inventory and floor space requirements, and improved part quality.

CYCLE TIMES

Of course cycle times depend on component size, amount of material removed, material removal rates and number of features. Cycle times range from 8 minutes for a small aero-engine shroud segment to 30 minutes for an IGT nozzle segment. **TOTAL COST** and **THROUGHPUT TIME** savings are equally important measures.



Radial Surface Grinding



FEATURES

	HUFFMAN MACHINES (4 OR 5 AXIS)	VERTICAL TURNING LATHES	RADIAL GRINDERS
FIXTURE(S)	<p>One or more fixtures mounted to the C-axis table or face of A-axis workhead.</p> <p>Fixtures are smaller, but sometimes more complex, exposing more surfaces of the part for grinding.</p>	<p>Full ring of parts in one fixture. Fixture is very big and expensive.</p> <p>Usually only expose one surface to be machined.</p> <p>Requires a 2nd fixture to machine other geometry.</p>	<p>Full ring of parts in one fixture. Fixture is very big and expensive.</p> <p>Usually only expose one surface to be machined.</p> <p>Requires a 2nd fixture to machine other geometry.</p>
COMBINING OPERATIONS	<p>By grinding one part at a time, chances are higher that more geometry can be reached in one grinding cycle.</p>	<p>Usually machine only one "side" of the part, for example Leading-Edge geometry. Part must be "flipped over" to expose other side.</p>	<p>Usually machine only one "side" of the part, for example Leading-Edge geometry. Part must be "flipped over" to expose other side.</p>
PROS	<p>Complete more geometry in one cycle.</p> <p>Low labor.</p> <p>Single-part flow.</p> <p>Low inventory.</p> <p>Since more geometry is machined in a single clamping, geometry (relative to other surfaces) is more accurate.</p>	<p>Machines some geometry fast.</p> <p>Geometry is consistent for all parts in the full ring.</p>	<p>Machines some geometry fast.</p> <p>Geometry is consistent for all parts in the full ring.</p>
CONS	<p>Only one part per cycle.</p>	<p>If something goes wrong, the machine scraps a full set of parts.</p> <p>Batch processing.</p>	<p>If something goes wrong, the machine scraps a full set of parts.</p> <p>Batch processing.</p>
CONSUMABLES	<p>EPCBN wheels, typically low abrasive cost per part.</p>	<p>Turning tools. Typically, turbine components are high nickel alloys, not friendly to traditional turning or milling tools.</p>	<p>Uses dressable wheels.</p> <p>Can use EPCBN.</p>

