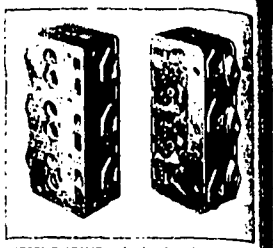
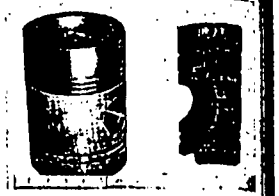


DUCTILE-IRON piston ring for a diesel engine is easily twisted without snapping into two parts. Cast-iron rings will break when they are twisted this far apart



DIESEL-ENGINE cylinder head of ductile iron has high fatigue, heat resistance



PISTONS for diesel engines can be made of ductile iron. Wearing quality is good

Ductile Iron, a New Design Material,

Steps Into Your Plant

Only three years old, this new iron is already proving its worth in many diesel-engine and pump parts. Here's a quick look at ductile properties, its many uses in the power plant and industry

► THE HIGH-BROW NAME for ductile iron is spheroidal graphite iron. Some call it nodular iron. But if you're a plant operator, all you need say is ductile iron, and everyone from purchasing agent to design engineer will understand you.

What Is It? Ductile iron contains a small amount of magnesium which eliminates flake graphite, the weakening agent in ordinary cast iron.

Ductile iron is a new iron. Unlike ordinary cast iron it isn't brittle; you can bend and twist it like the piston ring photographed above. Cast-iron ring bent like the one shown snaps, breaking into two parts. Greater ductility leads to better performance.

Can You Use It? You sure can. Ductile is readily available at moderate cost. Its strength is several times greater than ordinary cast iron; it is more ductile, has greater shock resistance. Foundry and machine-shop work are easier than for steel and gray cast iron. When you buy ductile-iron parts you get many of the advantages of steel.

Under stress, ductile behaves elastically like steel. It is now used for production of jobbing castings in many shapes, ranging in weight up to 100,000 lb. Different compositions of the iron are available for various uses. Some use nickel besides magnesium to obtain desired properties for special applications in different types of machines.

Diesel Engines. To prove how widely ductile iron is used, an entire diesel can be made of it. It will be a stiffer structure than those now made of cast iron. Some diesels distort under overloads, increasing internal friction and cutting power output.

Ductile-iron cylinder heads have much greater fatigue and heat resistance than those of gray cast iron. Failures from fatigue and overheating of heads have been common on some high-output railroad diesels.

Pistons. Large ductile-iron pistons can compete, on a weight basis, with those of aluminum. Ductile pistons have better wearing and heat-resistance qualities than aluminum.

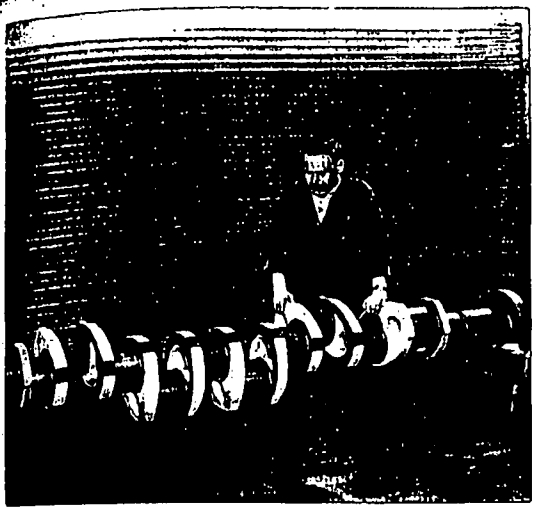
Piston Rings. German and English experience shows ductile-iron piston rings have 100% greater wall tension and 35% better wear life. High-speed European automotive engines do not have lateral flutter met with gray-iron rings running at high speed. Flutter causes early fatigue failure.

Because diesels run at much lower speed, the item of flutter probably does not exist. But at 700 to 800 F, ductile iron has properties similar to cast steel. So you can expect it to retain higher wall tensions than gray iron, especially at heavy overloads.

Cylinder Liners. Heat-treated ductile iron has high tensile strength, can be used for thin-walled liners. These increase heat transfer in engines having wet-type liners. Wet-type ductile-iron liners have not yet been built, but engine manufacturers are interested.

Crankshafts. Ductile-iron shafts have same fatigue resistance, better wearing qualities and lower cost than steel units. Casting a crankshaft cuts first cost considerably. For instance, a 2520-lb rough forging is needed to make a finished forged shaft weighing 657 lb. To make a cast shaft weighing almost the same when finished, 637 lb, a rough casting weighing only 700 lb is needed.

It has been said that a casting is the shortest and cheapest route between raw materials and finished product. Ductile-iron crankshafts may show this is true.



DUCTILE-IRON crankshafts have some fatigue resistance, better wearing qualities and cost less than steel crankshaft. Several engine builders are studying them

Wrought-steel products vary greatly in the efficiency of their material use. After machining, some weigh 50 to 70% of the original ingot. Others weigh only 10 to 20%. With precision casting, like the shell-molding process, we are much closer to our shortest route. Automotive crankshafts that need no machining are made this way. They are ready for service after being stripped from the molds, stress relieved, and ground.

Precision molding of ductile iron can save materials, cut parts cost.

Other Parts. What we've looked over so far are usually large, important parts of a diesel engine. But bearings, caps, valves and pumps can also be made of ductile iron. They show similar desirable properties.

General Uses. Besides diesels, ductile iron cuts right across the power engineer's field. Pumps, gears, tools, valves, pipes, sheaves, shafts and bearing parts are only a few of the many now being made of ductile iron. So if you're considering a new piece of equipment, why not ask the manufacturer's engineer if you'd save by having some parts made of ductile iron? You may be pleasantly surprised.

Properties. Now let's take a closer look at important engineering properties of ductile iron. These give you an excellent lead on where you may use this material for new equipment or parts in your plant.

Ductile iron responds to heat treatment like steel. It isn't particularly susceptible to cracking and can be quenched in either oil or water. Tensile strengths in the range of 150,000 to 180,000 psi are readily obtained, though most popular grade has 80,000 psi with 60,000-psi yield point. Tensile strengths as high as 230,000 psi have been achieved experimentally.

Compositions vary widely, depending on final use. Carbon content of ductile iron is usually higher than engineering grades of gray iron.

Silicon is an important alloying element in ductile iron. Each additional percentage increases tensile strength about 11,000 psi.

Castings. Unusual fluidity of ductile iron makes it ideal for intricate molds. It is said to reproduce intricate mold detail more faithfully than either aluminum or gray iron.

Pressure castings are expected to make widespread use of ductile iron. For instance, the cylinder head for a reciprocating compressor could not be readily cast in steel, and had inadequate properties when cast in gray iron. Ductile-iron head was as good as ordinary cast steel and cost less.

Wear Resistance. Lubricated or unlubricated ductile-iron surfaces have excellent resistance to mechanical wear. When not lubricated, resistance to galling and scoring equals the best grades of gray iron. Tests show ductile piston rings wear as well as the best piston-ring grade of open-grained flake graphite iron.

Gray iron gears in one pump handling crude petroleum have a 300-hr service life. Pitting and wear at pitch line are excessive. Ductile-iron gears in the same service run over 1000 hr with no deterioration or pitting.

Ductile iron is easily flame or induction hardened to 550-600 Brinell to give unusually high wear resistance. Heat and oxidation resistance of regular ductile-iron parts is far superior to gray cast iron.

You can arc-weld ductile iron the same way you weld gray iron. Ductile parts are now welded to steel, highly alloyed materials, and to ductile iron itself in the usual way. Welded joints in ductile-iron pipes are stronger than pipe itself though made without preheat or postheat.