



## Standard Practice for Preparation of Iron Castings for Electroplating<sup>1</sup>

This standard is issued under the fixed designation B 320; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This practice is intended to assist electroplaters in establishing and maintaining a satisfactory pre-electroplating cycle for malleable iron, gray iron, nodular iron, and white iron castings. It is also intended to indicate certain foundry practices which will facilitate subsequent finishing. Most of the practices that follow have been based on experience with malleable and gray iron. However, since they are related to the other forms, the same practices will probably apply. Nodular iron is also known as spheroidal or ductile iron, which is defined as cast iron with the graphite substantially in spherical shape and substantially free of flake graphite.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in 2.1.

### 2. Reagents

2.1 *Purity of Reagents*—All acids and chemicals used in this practice are technical grade. Diluted acid solutions are based upon the following assay materials:

Hydrochloric acid (HCl):	31 mass %, density 1.16 g/mL
Hydrofluoric acid (HF):	47 mass %, density 1.186 g/mL

**Caution**—Use hydrofluoric acid with extreme care.

Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> ):	93 mass %, density 1.83 g/mL
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**Caution**—Sulfuric acid should be slowly added to the approximate amount of water required with rapid mixing, and then after cooling, diluted to exact volume.

2.2 *Purity of Water*—Ordinary industrial or potable water may be used for preparing solutions and rinsing.

### 3. Foundry Practices

3.1 The seacoal content of the molding and facing sands should be maintained at the maximum practicable limits to minimize the occlusion of sand in the surfaces of the castings.

3.2 Upon removal from the molds, castings should be subjected to an abrading action (such as tumbling, grit blasting, or shot blasting) to remove as much as practicable of the occluded molding sand. Residual sand and scale may be removed, if necessary, by treatment in various proprietary descaling baths. These are usually based on fused caustic soda, some of which use chemical oxidizing or reducing agents and others employ electrochemical action as well. This is particularly important in the case of castings that will be annealed, to prevent the burning on of sand during this operation. Castings that will be warped or damaged by a blasting operation may be pickled in a solution containing 200 to 250 mL/L of sulfuric acid to remove occluded molding sand. See **Caution** in 2.1.

3.3 Annealed castings should be given an additional abrading as described in 3.2 to remove any scale that may have been formed, as well as graphitic carbon that may be present at the surface.

### 4. Nature of Cleaning

4.1 The preparation of ferrous castings for electroplating involves the following basic steps in the order named:

4.1.1 The removal of oils, greases, residual polishing and buffing compounds (if any), and shop dirt by cleaning,

4.1.2 The removal of oxide films and scales and the loosening of surface carbon by pickling or by salt bath treatment (see 3.2),

4.1.3 The removal of smut caused by 4.1.2, and

4.1.4 Activation for electroplating.

4.2 Where excessive amounts of cutting oils used in machining operations are present, it may be necessary to preclean the parts before they reach the electroplating room. This may require the use of organic solvents, vapor degreasers, washing machines of the power-spray type, emulsion cleaners, or simple alkaline soak tanks. As short a time as possible should elapse between this precleaning and the preplating cleaning cycle so as to prevent rusting of the parts. Where control of the interval is not possible, parts should be left with a slightly alkaline or very thin organic film.

### 5. Cleaning Solutions and Equipment

5.1 The various solutions used for the treatment of malleable and gray iron castings should be maintained by chemical analysis so far as is practicable, such as determining the free acid and iron concentrations of the acid baths and using tests

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee B-8 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.02 on Substrate Preparation.

Current edition effective Sept. 19, 1960. Originally issued 1957. Replaces B 320 – 57 T.

recommended by the manufacturer, the effective components of the proprietary cleaning solutions.

5.2 All solutions should be discarded before they lose their effectiveness, based on tests and experience.

5.3 When the amount of soil is excessive, particularly where no precleaning is done, it may be desirable to double the cleaning and pickling facilities. Thus, while the first of any two particular solutions becomes heavily contaminated, the second remains relatively clean and effective for further use. When the first of a pair of solutions is discarded, it is replaced by the second solution and a fresh second solution is prepared. This system also reduces the possible carry-over of contaminants such as oil and grease into subsequent solutions.

5.4 Where doubling the facilities is impossible or impracticable, similar economies may be obtained to a degree by providing cleaner and pickle tanks with overflow dams, sumps and pumps with which the solution may be recirculated. The pump intake should be located approximately half-way down the sump to preclude returning either settled-out solid dirt or surface oil and grease to the processing tank. The outlet should be near the bottom of the processing tank at the end opposite to the overflow dam so as to create some solution turbulence (for mechanical scrubbing benefits) and to ensure flow of contaminated solution to the dam.

5.5 In electrified tanks removable electrodes should be employed in preference to using the tank as an electrode, to facilitate inspection and cleaning. To ensure good circuitry, positive contacts such as an inverted V hook for round bars should be used. In alkaline cleaner tanks, where clean contact is often a problem, submerged oversized steel tank rods are effective.

5.6 All immersion rinse tanks should be equipped with dam-type overflows to ensure skimming of oil, grease, and light dirt from the surface of the water. Water inlets should be at the bottom of the tank, and should be of a size sufficient to provide an adequate flow of water. It is desirable that submerged inlet pipes be equipped with syphon-breakers (as required by law in many areas) not only to prevent the backflow of contaminated water into the mains, but also to produce a beneficial turbulence or scrubbing action due to the air introduced with the water. Agitation by means of low-pressure, oil-free air through perforated pipes at the bottom of the tank may also be used.

5.7 Having the heating coils on the working side of tanks will assure a working surface which is free of accumulated grease and oil.

## 6. Procedure for Racked Parts

6.1 The following cycle may generally be used for racked parts which will subsequently be electroplated in still tanks, semiautomatic equipment, and full-automatic equipment:

6.1.1 *Precleaning*—When castings have been subjected to machining, polishing, buffing, or similar finishing processes, it is desirable and frequently essential that lubricants and finishing compounds be removed by precleaning immediately following such operations. This is especially important when the lubricants contain unsaturated oils which, upon air oxidation,

form films which are extremely difficult to remove. Precleaning methods as listed in 4.2 may be employed.

6.2 *Soak Cleaning*—In the event precleaning of a heavily soiled part is impossible or impracticable, soak cleaning to loosen oils and greases is recommended. The bath may be either an alkaline solution of such concentration as recommended by the supplier, and operated at a temperature as close to boiling as possible, or an emulsion-type cleaner operated as specified by the supplier. In either case, agitation of the solution by air or solution pumping, or movement of the part, will prove beneficial. The time may be 5 min or more.

6.3 *Rinse*—If the soak cleaner used is incompatible with the subsequent cleaner, a rinse is indicated. The supplier will normally suggest whether it is to be warm or cold, although a warm rinse (60°C) is usually desirable following alkaline soak cleaning. In any case, agitation of the rinse water is desirable; and, in the case of cold-water rinses, a spray upon leaving the tank is beneficial. The time of rinsing depends in part upon the shape of the part, but should be no less than 10 s.

6.4 *Anodic Cleaning*—The part is made the anode in a solution of a properly compounded alkaline cleaner of a concentration recommended by the supplier. The cleaner should be free-rinsing, and of high conductivity to permit a current density of 6 to 10 A/dm<sup>2</sup> at a tank potential of 6 to 9 V. The solution temperature should be from 90 to 100°C, and the cleaning time from 1 to 2 min.

6.5 *Rinse*—The supplier of a proprietary cleaner will usually indicate whether his product rinses more freely in warm or cold water. In general, rinsing should be done as described in 6.3, but preferably in a separate tank. Where practicable to do so, all rinses should be double rinses; that is, two separate rinses in succession, with the second cascading into the first for water economy.

6.6 *Acid Pickling*—This stage of the cycle is the most critical, and its operating conditions are dependent on the type of electroplating to follow. Most of the difficulties in electroplating of gray iron and malleable iron castings are caused by the free graphitic carbon, flake or nodular, which is present at the surface of the part. If the subsequent electroplating will be done under conditions causing sufficiently high hydrogen overvoltage (most acid solutions, and such alkaline solutions as copper, cadmium, or tin), a brief dip (less than 15 s) in a room temperature solution containing 200 mL/L of hydrochloric acid or 50 to 100 mL/L of sulfuric acid is usually adequate. See **Caution** in 2.1. If the electroplating will be done in an alkaline solution of low hydrogen overvoltage such as cyanide zinc, anodic treatment in acid to remove surface carbon is preferred. This is done by making the part the anode in a solution containing 250 to 350 mL/L of sulfuric acid for at least 30 s, preferably more, at a voltage sufficient to provide a current density of at least 10 A/dm<sup>2</sup>. See **Caution** in 2.1. A black film of carbon smut will form during the first 15 to 30 s, then the part will become passive and the oxygen evolved on the part will remove the carbon by a combination of scrubbing and oxidation, leaving the casting relatively clean.