where a required test would be completed after shipment of the forging to the purchaser. As an example, the purchaser might wish to do the necessary machining prior to the required ultrasonic examination for a forging being produced to Specification A 508/A 508M, so that the final certification and marking would be completed at the purchaser's facilities. Supplemental marking by the use of bar coding is covered in this section also.

Reference has been made to the Supplementary Requirements section of the standard in this review. When the general requirements specification was written, it was found that many of the product specifications included the same supplements such as those covering residual elements or grain size. These common supplementary requirements were gathered together and placed in Specification A 788 where they are available for purchaser use.

Generally, the rule is that a supplementary requirement is intended to add to the requirements of the product specification, not detract from them.

When a supplementary requirement is included in the purchase order, it may have a significant effect on the manufacturing process. For example, if in ordering a forging to one of the grades in Specification A 266/A 266M, Supplementary Requirement S13 on Charpy Impact Tests from Specification A 788 is included, then changes in the manufacturing process such as the use of a quench and temper heat treatment cycle instead of a normalize may be necessary, as well as more extensive machining before heat treatment. Such changes could require discussion with the forging supplier beforehand, since in the case of Specification A 266/A 266M the purchaser must agree to the use of a quench and temper heat treatment cycle.

The Supplementary Requirement lists that are a part of Specification A 788 are worthy of study by the forging purchaser, since they provide a useful means of upgrading a forging to better meet an intended use, as for example S24 for the J Factor in controlling temper embrittlement. As another example, S12 on tension test specimens for hubbed tube sheets could help ensure that the application code requirements are met. The former requires that the element tin be determined for the heat or product analysis, something that may not be part of the product specification, while the latter covers a materials requirement that is somewhat buried in Section VIII, Divisions 1 and 2, of the ASME Boiler and Pressure Vessel Code.

Supplementary Requirement S26 is intended to assist producers in meeting the requirements for forgings used in applications where the European Union Pressure Equipment Directive is in force and includes minimum requirements for the Charpy Impact test, as well as for minimum tensile elongation values based on a gage length of 5D as opposed to the 4D requirement in Specification A 370, where D is the diameter of the tension test specimen.

Although applied only by the purchaser's choice, the supplier should be cognizant of the available supplementary requirements, and be prepared to discuss them with the purchaser.

## Specification A 961/A 961M-04a Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications

This specification, now in dual format, was written by the Section on Forgings of Subcommittee A01.22 on Steel Forgings and Wrought Fittings for Piping Applications and Bolting Materials for Piping and Special Purpose Applications. The specification is an integral part of nine forging product standards that are intended for the use of the steel pipe fittings industry, and many of these are very widely used. The specification was written to take into account the size range for flanges and fittings used in piping applications, bearing in mind that these items are often manufactured for stock applications.

The Manufacturing section (6) includes some important starting material provisions. The basic premise is that the part will be made from a forging that has been produced as close as practicable to the finished size and shape. This will depend on the method of forging, for example closed (impression) die or open die, and to some extent on the philosophy of the producer regarding time spent under the forging press and the extent of machining. Alternative starting ma-

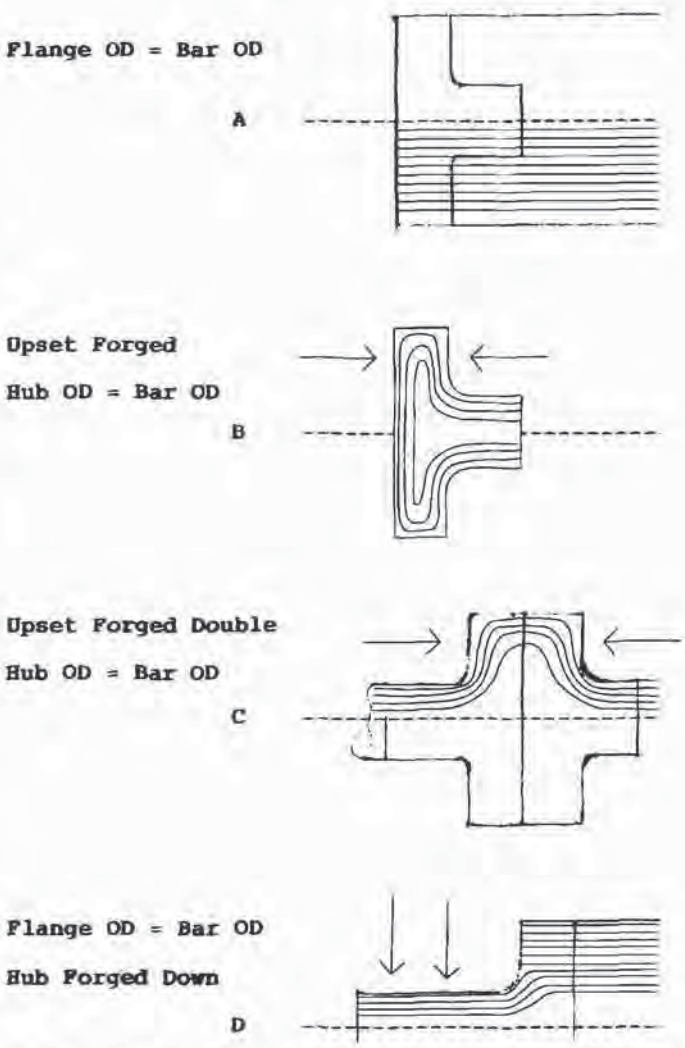


Fig. 14.1—Sketches of methods to produce flanges to an ASTM steel fittings specification using forged or rolled bar stock as the starting material: Method A, direct machining from bar is not permitted by the fitting specifications; Method B, by upsetting the flange from a starting bar size close to the flange hub size; Method C, by upsetting a double flange forging from bar close to the hub diameter; Method D, by starting with a bar size equal to the flange OD and forging the hub down. This may not be permissible by the fitting specification rules.

terial forms can be used within some defined limitations. The direct machining of rolled or forged bar material (note the definition from the terminology Section 3.1.1) is not permitted for flanges, so that the implication is that these components must be forged to shape. The exhortation to be as close as possible to the finished shape would seem to indicate that flanges should be forged individually rather than, for example, upset forged as a double and then cut apart. However, as Fig. 14.1 shows, this would seem to be a reasonable and economic way to make them. Another manufacturing route would be to select a bar with the same outside diameter as the flange and forge the bar down to make the flange hub, also shown in Fig. 13.1. This would certainly be close to the finished shape, but the flange would still be machined directly from the bar, and although having a favorable grain flow between the flange and the hub may not be in accordance with 6.1.1 of the specification. While the intent of these words may be clear, economics inevitably comes into the picture, and the restriction on directly machining flanges from any type of bar or seamless tube is much more meaningful.

Cylindrical parts, other than flanges, up to and including the NPS (Nominal Pipe Size) 4 can be machined from bar, but elbows, tees, header tees, and return bends cannot be machined directly from bar stock, regardless of the NPS size. The rule is that the longitudinal axis of the part must be near parallel to the axis of the bar, to avoid crossing the grain flow of the bar. There is no size limitation on cylindrical parts made from seamless pipe or tube, but the exclusion of flanges and nonaxial components such as tees and elbows still applies.

In common with other standards under the wing of Committee A1, Chemical Requirements (8) requires that Test Methods, Practices, and Terminology Standard A 751 be used for both heat and product analyses. It should be remembered that while in many cases the starting material for forging product standards covered by Specification A 961 will have been produced to specifications for other product forms such as hot finished bar and seamless tube, the requirements of A 961 would be expected to take precedence.

The Mechanical Requirements are shown in Section 9 and Specification A 370 is referenced as the test methods source. When the starting material is bar or tube whose heat treatment satisfies the requirements of the fittings specification, and when no heat treatments have been done after the mechanical testing of the stock, then mechanical test results from the starting stock can be used to satisfy the fitting specification requirements. While this is a useful provision for the manufacture of small parts, care should be taken to ensure that the heat treatment and mechanical test certification for the starting stock does really meet the particular fittings product specification requirements, since these are often quite specific with regard to temperatures and methods of cooling. Some words are also included concerning the manufacture and use of separate test blanks that are permitted in many of the product specifications. These separate test blanks can reduce mechanical testing costs appreciably, but have been a source of dissatisfaction in the past for forgings made to these product specifications when testing of an actual forging has been shown to give failing test results, although acceptable values were reported from the test blank. This is particularly the case when Charpy impact testing is required.

There is a common tendency for assorted forgings, other than for flanges, valves, and fittings for piping applications, to be made to the forged fittings product specifications. These applications frequently exceed the intended scope of the product specification test provisions with the potential for rejections and failures.

## References


[1] *Annual Book of ASTM Standards*, Section 1, Iron and Steel Products, Volume 01.05, Steel Bar, Forgings, Bearing, Chain, Springs.

[2] *Annual Book of ASTM Standards*, Section 1, Iron and Steel Products, Volume 01.01, Steel Piping, Tubing, and Fittings.