

**PURPOSE:** To communicate to Hardinge suppliers of manufactured parts, these general practices and guidelines have been developed by Hardinge Manufacturing Engineering. These practices are not intended to supersede any specifications on Hardinge Engineering drawings.

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**I. CENTER DRILLING**

- 1) When center drilling the second end of a part, the part must be checked between centers to verify run-out (both ends are to be concentric within 0.005" [0.13mm] full indicator movement). Surfaces not machined later must not exceed any square, true, concentric, or parallel tolerance specification on the Engineering drawing. **RUN-OUT MUST BE CONSIDERED TO AFFECT ALL FUTURE MACHINING OPERATIONS OF THE PART.**

\*\*\* NOTE: If there is no given tolerance, run-out is assumed not to exceed 0.005 full indicator movement.

- 2) Radius Center: Must be used if specified on Engineering drawing. Example: 1/16 Radius Center

**2. THREADS**

- 1) Inch threads: Class GH-4 or GH-5 fit should be used on parts which are going to be heat treated (specifically carbonization). This allows for (Standard) fit after Heat Treat. (Hardinge Standard).  
Metric threads: A pitch diameter limit D4 or D5 tap should be used on parts which are going to be heat treated (specifically carbonization). This allows for (Standard) fit after Heat Treat. (Hardinge Standard).
- 2) Drilled and tapped holes that are deeper than the Engineering drawing are acceptable, providing no datum or intersection holes are affected. This only applies when there is no maximum thread depth specified on the Engineering drawing. (per Manufacturing Engineering).
- 3) Countersinks are acceptable when the Engineering drawing calls for a 0.030" to 0.060" [0.75mm to 1.50mm] counterbore on threaded holes. This is used purposely for burr removing. (Per Manufacturing Engineering) This allows extra depth for grind stock when necessary.
- 4) No stripped, broken, torn, chattered or loose (up & down play) threads are acceptable.
- 5) Screw thread inserts are not acceptable, unless approved by Design Engineering.
- 6) Certified thread gauges are to be used.
- 7) All threads must be free of chips, grinding dust, burrs, or other debris that prevents gauges from going into proper depth, especially before going to carbonization and hardening. (Assembly will do minor cleaning of the threads).
- 8) Lead error must be checked on long (over 1" [25mm]) threaded parts, even if the Engineering drawing may not specify a tolerance).

\*\*\* NOTE: Acceptable lead error tolerance may vary depending on the application or assembly of the part.

**3. CHAMFERS**

- 1) Chamfers are to be measured across the face of the flat unless otherwise specified.
- 2) 45° unless specified. All other angles must be specified, if not contact Hardinge Engineering.

**4. ANGLES**

- 1) All angles specified in degrees only (with no specific tolerance) will be acceptable at +/- 30 minutes.
- 2) All angles specified in degrees and minutes (with no specified tolerance) will be acceptable at +/- 5 minutes.

**5. STRAIGHTENING**

- 1) Parts are to be straight within 0.005 [0.13mm] total indicator movement unless otherwise specified on the Engineering drawing.

\*\*\* NOTE: Straightness must be considered to affect all future machining operations of the part to hold tolerances less than or equal to .005 [0.13mm] (when used for locating purposes).

- 2) When straightening lead screws, feed screws, etc., locate datum from V - block whenever possible.

**6. KEYWAYS / SLOTS**

- 1) Keyways or slots are to hold +/- 0.005" [0.13mm] on the centerline.  
0.010" [0.26mm] total indicator reading unless otherwise specified on the Engineering drawing.
- 2) Depth of slots / keyways on cylindrical parts are dimensioned and measured from across the flats to the bottom of the slot (not the O.D.) unless otherwise specified on the Engineering drawing.

**7. SQUARE & TRUE**

- 1) It is assumed that faces and shoulders are to be flat to concave within the Engineering drawing true specification or tolerance unless otherwise specified.
- 2) Squareness is to be checked in (2) planes whenever possible. It should be checked in (2) places, 90 degrees apart with an indi-square, or 180 degrees between centers.
- 3) Milled faces are to be flat and square within 0.005 [0.13mm].  
0.010 [0.26mm] is acceptable on .375" [10mm] or thinner plates or covers, unless otherwise specified.  
\*\*\* Squareness must be considered a factor for future operations where there is a requirement to hold tolerances less than or equal to 0.005" [0.13mm] when a milled surface is used for locating purposes.

**8. STOCK ALLOWANCE FOR FINISHING MACHINES**

- 1) Allow 0.030" [0.75mm] on the diameter for finish turning.
- 2) Allow 0.007" [0.20mm] for fly-cut.
- 3) Allow 0.007" [0.20mm] per side for grind.
- 4) G.A. (grind for appearance) 0.007" [0.20mm] undersize per side is allowed.

**9. BURRS / MISCELLANEOUS**

- 1) It is the operator's responsibility to remove burrs, if:
  - a. No burring operation follows the responsible operation.
  - b. Operator creates burr.
  - c. The burr causes problems for future operations (for example: locating purposes).
- 2) Corners must be broken even though the Engineering drawing may not call for it, unless otherwise specified. Recommended: 0.03" [0.8mm] x 45-degree chamfer or 0.02" [0.5mm] radius.

**10. GAUGING & INDICATORS**

- 1) All gauging & inspection devices (calipers, micrometers, Jo blocks) must be calibrated with valid certification dates.

**11. ENGINEERING DRAWING QUESTIONS OR CONCERNS**

- 1) Any surfaces, tolerances and specifications that may be missing or not clearly specified on the Engineering drawing should be brought to the attention of Hardinge Purchasing Department immediately. (Refer to the Purchase Order for the Buyer name)
- 2) Questions regarding inspection processes and gauging should be directed to the Hardinge Inspection Department. Please have the part number and revision level information available.

**12. DEVIATIONS**

- 1) To avoid any confusion, deviations obtained verbally must be noted on the supplier's process paperwork and a copy of the deviated specification included with the part when it is returned to Hardinge. The same rules apply to written/emailed/faxed deviations. Please note the name of the Hardinge representative who authorized the deviation and the date discussed.

**13. FEEDBACK**

- 1) Hardinge values its partnership with manufacturing suppliers and is open to suggestions and concerns. This information should be directed to the Hardinge Purchasing department via email, fax, or telephone.

**14. REVISION LEVEL CONTROL**

- 1) It is the responsibility of Hardinge Purchasing & Sourcing to ensure suppliers are provided with the latest drawing revision. Any questions regarding revision levels on the Engineering drawing should be brought to the attention of Hardinge Purchasing Department immediately. (Refer to the Purchase Order for the Buyername)

**15. FINISH - BLACKEN**

- 1) The standard process for blackening metal parts approved by Hardinge Inc. Engineering is a hot salt bath type black oxide process. The result must have a finish with a deep black coloring and void of any shading or color variations. Hardinge Inc. recommends parts be thoroughly cleaned afterwards to remove salt deposits and then dipped or sprayed with a rust preventative.

















**16. FINISH - PAINT**

NOTE: All materials and processes used in the application of paint to Hardinge Inc. parts must meet all applicable regulations. SDS or MSDS data sheets for all products will be available by request.

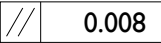
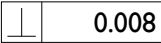
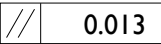
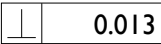
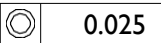
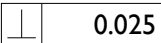
- 1) On Castings:
  - a. Unless otherwise specified, the standard process for painting castings will require a 2-part Polane primer and 2-part Polane paint.
  - b. Castings must be free and clear of all contaminants, oils and any other debris that may affect the adhesion of paint to the casting surface.
  - c. Excess foundry slag and mold parting lines are to be removed prior to paint.
  - d. All surfaces of the casting are to be primed and painted unless specified otherwise on the Engineering drawing.
- 2) On Sheet Metal:
  - a. Sheet metal must be free and clear of all sharp edges, oils and all other debris which may affect the adhesion of paint.
  - b. The application of primer and paint to all sheet metal and other selected parts will be done by a Powder Coat process unless specified otherwise.
- 3) Special Paint:
  - a. Special paint customer requirements may be done via powder coat or 2-part Polane paint. Typically special paint is applied via 2-part Polane paint in order to meet the customer's exact color specifications for a small quantity of paint.

**17. SURFACE FINISH (when micro is not specified)**

I) Inch Units

Geometry or Operation	Ra
Diameter or face with .001 or .002 total tolerance	63 
Diameter or face with  0.0003  0.0003	32 
Diameter or face with  0.0005  0.0005	32 
Diameter or face with  0.001  0.001	63 
Diameter or face with 0.005 total tolerance	63 
Diameter or face in O-ring groove	63 
Diameter or face with +/- 0.005 or greater tolerance	63 
Drilling	250 125 
Milling / Reaming	125 63 
Grinding	32 16 

2) Metric Units (Millimeters)

Geometry or Operation	Ra
Diameter or face with .025 or .050 total tolerance	$\sqrt{1.6}$
Diameter or face with  0.008  0.008	$\sqrt{0.8}$
Diameter or face with  0.013  0.013	$\sqrt{0.8}$
Diameter or face with  0.025  0.025	$\sqrt{1.6}$
Diameter or face with 0.13 total tolerance	$\sqrt{1.6}$
Diameter or face in O-ring groove	$\sqrt{1.6}$
Diameter or face with +/- 0.13 or greater tolerance	$\sqrt{1.6}$
Drilling	$\sqrt{6.3}$ 3.2
Milling / Reaming	$\sqrt{3.2}$ 1.6
Grinding	$\sqrt{0.8}$ 0.4

**18. ABBREVIATIONS:**

Ra -= Roughness Average

GA = Grind for Appearance

**19. IRON CASTING SPECIFICATIONS****19.1 General Specifications**

- 1) All castings upon visual inspection, with emphasis on critical areas, will be free from surface defects, such as sand holes, gas holes, recessions, extrusions, burnt on or burnt in sand, and other defects detrimental to machinability or performance.
- 2) Internal porosity is not acceptable and will be cause for rejection if found in critical areas. Porosity in other locations will be formally reviewed for acceptance.
- 3) Following pre-production sample approval, no processing changes shall be allowed unless approved in writing. These changes include, but are not limited to, molding, coremaking, melting and the location of manufacturing.
- 4) Holes in castings, such as sand holes or shrinkage, shall not be filled in any manner (welding, liquid metal, epoxy, etc.) unless approved in writing using the Nonconforming Material Report.
- 5) Where positive metal removal is required (ingates, risers, parting line flashing, etc.), no gouging is permitted.
- 6) Any heat treatment done by or for the production foundry shall have sufficient accessible support documentation retained for a period of one (1) year from the date of shipment.
- 7) The location for hardness testing will be specified by the Engineering drawing.

In the absence of a specified location, the test bar types controlling section thickness will be used as a guide for the test area. For example, "B" type specification will be tested in a 0.50" to 1.00" [13mm to 25mm] section thickness.

- 8) The iron microstructure shall be less than 2% free carbide or steadite.
- 9) Iron mechanical properties (tensile strength) shall be used to specify the grade required.
- 10) Normal casting surface finish:

Hardinge China

Reference GB/T 6060.1-1997.

Hardinge Taiwan

No data available.

Hardinge US

Surface finish shall be 560 micro inch [14.224 micron] RMS maximum. The GAR cast microfinish comparator number C-9 shall be used for determining the surface finish.

- 11) Special casting surface finish:

Hardinge China

Reference GB/T 6060.1-1997.

Hardinge Taiwan

No data available.

Hardinge US

Surface finish shall be 420 micro inch [10.668 micron] RMS maximum. Castings requiring this finish shall be specified on the purchase order.

**19.2 Gray (Flake) Cast Iron**
**1) Mechanical Properties of Gray Cast**

Iron:Hardinge China

Reference GB 9439.

Hardinge Taiwan

No data available.

Hardinge US

ASTM A-48 shall be followed for determining the mechanical properties of gray cast iron. The testbar type will be determined by the controlling section thickness as follows:

Controlling Section Thickness (Inches)	Test Bar Type	Cast Bar Diameter (Inches)	Machined Bar Diameter (Inches)
0.25 - 0.50	A	0.88	0.50
0.51 - 1.00	B	1.20	0.75
1.01 - 2.00	C	2.00	1.25

**2) Test Bar Type:**

Hardinge China

Reference GB 9439.

Hardinge Taiwan

No data available.

Hardinge US

ASTM A-48 type "B" test bar shall be used unless otherwise specified.



- 3) The hardness and microstructure shall be as shown in the following tables:Hardinge China

Grade	Microstructure	Hardness for Given Section Thickness (Millimeters)			
		6.35 - 12.7	12.7 - 25.4	25.4 - 50.8	50.8 - 76.2
HT150	Ferrite - Pearlite	Less than 200 BHN in all sections			
HT200	Pearlite	-	170 - 200	165 - 195	160 - 190
HT250	Pearlite	-	180 - 210	175 - 205	170 - 200
HT250	Pearlite	-	190 - 220	180 - 210	175 - 205
HT300	Pearlite	-	200 - 230	185 - 220	180 - 210

Hardinge Taiwan (JIS G5501)

Grade	Hardness
FC200	170 - 210
FC250	180 - 220
FC300	190 - 230
FC350	200 - 240

Hardinge US

Grade	Microstructure	Hardness for Given Section Thickness (Inches)			
		.25 - .50	.50 - 1.0	1.0 - 2.0	2.0 - 3.0
25B	Ferrite - Pearlite	Less than 200 BHN in all sections			
30B	Pearlite	187 - 217	174 - 202	156 - 187	134 - 170
35B	Pearlite	202 - 235	187 - 217	170 - 202	156 - 187
40B	Pearlite	228 - 269	207 - 248	187 - 228	174 - 207

- 4) When corrosion resistant iron is specified, the iron shall be alloyed with 0.5% to 1.0% copper.

**19.3 Ductile Iron**

- 1) ASTM A-536 shall be followed for determining the mechanical properties of ductile iron.
- 2) The hardness and microstructure shall be as shown in the following

tables:Hardinge China

Ductile iron not used by Hardinge China.

Hardinge Taiwan (JIS G5502)

Grade	Hardness
FCD450-10	140 - 210
FCD500-7	170 - 230

Hardinge US

Grade	Microstructure	Hardness	Thermal Treat
65-45-12	Ferrite	156 - 220	Annealed
80-55-06	Pearlite	200 - 262	As cast

**19.4 General Dimensional Tolerances per Dimension for Non-Machined Sand Casting Surfaces**
**1) Molded in surfaces:**

Hardinge China

Casting Dimension (mm)		Tolerance (CT10)
□	▭	
-	10	2
10	16	2.2
16	25	2.4
25	40	2.6
40	63	2.8
63	100	3.2
100	160	3.6
160	250	4
250	400	4.4
400	630	5
630	1000	6
1000	1600	7
1600	2500	8
2500	4000	9
4000	6300	10
6300	10000	11

Hardinge Taiwan

No data available.

Hardinge US (Refer to the illustration on page 14.)

Dimension	□ 6	> 6 - 12	> 12 - 24	> 24 - 36	> 36	Example
Outside Surfaces	+/-0.04	+/-0.06	+/-0.16	+/-0.25	+/-0.30	A
Inside Surfaces	+/-0.04	+/-0.06	+/-0.16	+/-0.25	+/-0.30	B
Location of Ribs and Bosses	+/-0.04	+/-0.06	+/-0.16	+/-0.25	+/-0.30	C
Fillet Radius	+/-0.04	+/-0.06	-	-	-	D
Wall and Rib Thickness without Draft	+/-0.04	+/-0.06	-	-	-	E
Boss, Pad and Flange Profile	+/-0.04	+/-0.06	-	-	-	F
Boss, Pad and Flange Thickness and Depth	+/-0.04	+/-0.06	-	-	-	G

- 2) For cored features, use the general tolerance with an additional 0.03" [0.8mm].  
 Example:  
 An inside cored feature (cored hole) 8" in diameter will have a tolerance of +/-0.09".  
 An inside cored feature (cored hole) 200mm in diameter will have a tolerance of +/-2.3mm.
- 3) Dimensions 90 degrees to the parting line shall have tolerances 0.03" [0.8mm] greater than the applicable general tolerance.

19.5 Machine Finish Tolerance, Unless Otherwise Noted on the Engineering Drawing, Shall be as Follows:

1) Inch Units

Dimension	□ 6	> 6 - 12	> 12 - 24	> 24
Outside Surfaces	0.12 - 0.18	0.12 - 0.18	0.18 - 0.25	0.25 - 0.31
Inside Surfaces	0.12 - 0.18	0.18 - 0.25	0.25 - 0.31	0.31 - 0.37

2) Metric Units (Millimeters)

Dimension	□ 150	> 150 - 300	> 300 - 600	> 600
Outside Surfaces	3.0 - 4.5	3.0 - 4.5	4.5 - 6.5	6.5 - 8.0
Inside Surfaces	3.0 - 4.5	4.5 - 6.5	6.5 - 8.0	8.0 - 9.5

19.6 Warpage (flatness) tolerance shall

be: Inch Units

0.06" per 12" of casting

Castings larger than 6' will have a maximum of 0.375" warpage.

Metric Units

1.5mm per 300mm of casting

Castings larger than 1.8m will have a maximum of 9.5mm warpage.

19.7 Casting tolerances other than listed in this document will be indicated on the Engineering drawing.

19.8 Should a characteristic have multiple tolerances, the tightest tolerance shall apply.

19.9 Casting mass

tolerance: Hardinge

China

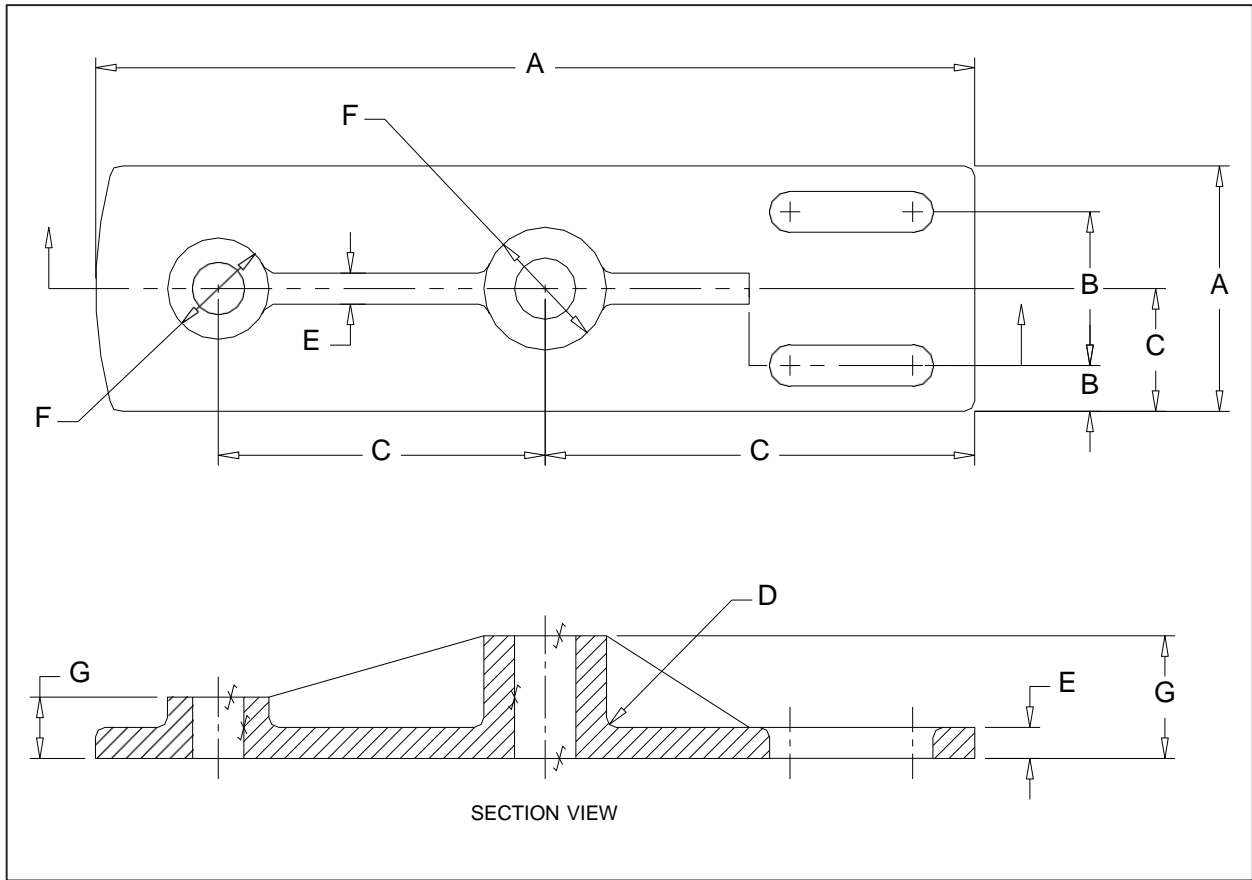
Reference GB/T 13351-1989.

Hardinge Taiwan

No data available.

Hardinge US

No data available.



Casting Specifications Drawing