

A compilation of practical ideas and proven methods for extending die life.



of NADCA Die Materials Committee

North American Die Casting Association 9701 Higgins Rd. Rosemont, Illinois

### THE CARE AND MAINTENANCE OF DIE CASTING DIES

# Contributors

- Tim Ballard
   Mid-South Manufacturing
- Henry Bakemeyer
   Walkington Engineering, Inc.
- Richard Brown
   Cascade Die Casting Group
- Derek Cox
   Eastern Alloys, Inc.
- Gary Dilbeck
   Texas Die Casting
- Gerald Dunne
   Hartzell Manufacturing
- Arnie Fulton
   Shelby Die Casting
- Lowell Gregerson
   Hartzell Manufacturing

- Robert Hughes
   Supreme Tool & Die
- Jim Jessonge
   DuPage Die Casting
- Paul Johnson
   PHB-Parker Die Casting
- Mitch Lewin
   Mitch Lewin Inc.
- Toby Parks J&E Die Casting
- Robert Shea, Chairman Harvard Industries
- Jerald Skoff Badger Metal Tech
- Bob Uhrman
   Saturn Corporation

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# I. NEW DIE CAST DIES



# Visual Inspection

Visual inspection of a new tool is very crucial. Every new tool should be thoroughly inspected, if possible, by both the die caster and the die builder. Many times a set-up and sample run can be saved from failure by carefully looking at the tool before it is put in the machine for the first time. If the inspection is done at the tooling source, there can be additional freight, set-up, and sample cost savings.

The best time to visually inspect a die is when it is completely finished and assembled. The die must be opened into two halves for easy access at inspection. The cast tool should exhibit the final "bluing" for fit to illustrate proper cavity and feature closure.

It is important to use a check list when inspecting a die. The check list serves the following purposes:

- A reminder to check all items so none are overlooked.
- A permanent record to be placed in your tool record/history file.
- A hit list to send back with the die to die builder if corrections are required.

A sample check list is provided on the following pages.





# New Die Check List

Customer	Die No
Part No.	Date
Built by	Inspected by

# Cavities - Conformance to Tool Standards

	All the cores are in place
	Core pin drawings available in diagram form on 8 1/2" x 11" sheets
	Core pins have proper draw polish
	Core pins have proper surface treatment
	Surface finish of cavity is acceptable
	Entire parting line seals off
	Steel certification
	Heat treatment certification
Ш	Engraving correctTrademark,
_	P/N,Cav. No.,Date code
Ц	Ejector pins correct length
Ц	Ejector pins correct location
Ц	Water lines open and circuits per die layout
Ц	Water line plugs installed
Ц	Water lines clearly labeled with up to date diagram charts available
Ц	Plumbing and electrical systems do not interfere with die set and pull
Ц	Fillet and corner radii correct
Ц	Cast-in inserts fit retaining devices
Ц	Cavity is reverse to part print
님	Cavities are .002"/.003" raised
H	No damage from shipment
Ш	Polished out all EDM marks

No unspecified sharp	
I I INO LINSDECITIED SPAR	) corners or knite eddes
	Conners of Rime cages

Cavities have been given final stress tempering to provide oxide coating on surface

- Wax shot taken to check for wall thickness, under cuts, etc. when practical
- Plug in thermocouples and satisfy at room temperature
- Plug in limit switches and test
- Pressure test all water, hydraulic, and oil lines
- Move slides and ejector plates to check limit switches at ends of travel



# Metal Feed System Conformance to Tool Standard

- Cold Chamber hole/sprue post & bushing correct size
- Runner system to die layout
- Runner polished smooth with adequate draft
- In gates correct size
- Overflows correct size and position
- Adequate ejector pins in runners & overflows per die layout
- Overflow gates cut in die
- □ Vents cut in die correctly
- Accelerated ejector pins have push pads



# Ejector System - Conformance to Tooling Standard

Ejector plate moves freely
Top ejector stops set so that they never hit in operation but protect waterline
when the die is maneuvered or flipped
Water hoses and piping clamped in place to avoid vibrating into a path of
 destruction
All ejector pins in place
All ejector pins, return pins, ejector guide pins are greased
Ejector plate guide pins in place
Ejector pins on contoured surfaces keyed
Ejection length stamped on outside of die if practical
Ejector plate stops in place and set to proper height
Return pins flush to .002 above P/L
Hook-up for hydraulic ejection correct
Ejector pins on runners and over flows cut 1/16" to 1/8" low
Exposed surface of the ejector plates are painted OSHA orange/yellow to
designate moving plate



# Mold Base - Conformance to Tool Standard

	Adequate eye bolt holes centered for balance of die in each half
	Eyebolt holes present on four sides of the die to allow easy maneuvering
	Clamp slots per layout
	Cover half,Ejector half
	Guide pins, bushings per layout
	Pry bar slots in place
	Support pillars per layout
	Proper identification on outside of die
	Water line numbers,Die No.,Customer,
	Weight of die,Part NoTool Builder
	Die goes together properly
	Clean out slots under leader pin bushings
	Satisfactory quality and workmanship with burrs removed and corners
	broken
	One leader pin offset to prevent incorrect assembly
	Leader pins greased
	Thermocouples in place
	Damaged during shipment
	Correct shut-off height
	All bolts in place and tight
	Hot oil/water manifolds per print
	Cam pins are proper length
	Slide locks are proper size
	Cavity has knock-out holes
Ш	Legs on die to enable it to stand on floor without crushing waterlines and
	thermocouples
Ш	Set screws behind core pins

# Slides - Conformance to Tooling Standard

Slides move freely
Slides shut-off properly
Hydraulic cylinders/limit switches timed with slide movement
Locks blued-in
Slides that project above parting line are drafted or relieved to prevent galling
Slides can be removed safely while die is in machine
Eye bolts holes as required
Slides have positive forward stop
All bolts in place and torque in sequence
Slides greased
Angle pins and angle pin holes have lead-in radii
Slides have sufficient stroke to clear casting and for blow off access if
 necessary
Proper water lines in slides
Slide retaining mechanism in place for top slides
Proper fit of gibs
Slide locks set when die is HOT

# Setting Up, First Time

The following are some guidelines for setting up a new die for the first sample run:

- > Be sure set-up men are aware of any unique features on the die
- > Be sure die fits in the intended machine
- > Use a good cold chamber and tip that are the correct size
- Proper tip clearance using formula = .001" per inch + .001"

For example: a 4" tip diameter requires .005" clearance

- Hook up all hot oil/water lines
- > Hook up all hydraulic cylinders and electrical limit switches
- Carefully dry cycle die watching for interference between die halves, slides, ejection system, stationary cores.
- Install water lines per die layout
- Die carrier adjusted

<u>REMEMBER</u> - Many die cast machines operate differently when in the Jog mode versus Automatic mode. Dry cycle the die manually then dry cycle on automatic.

- Hook up all thermocouples
- > Be sure Bumper rods are in an adequate pattern and the correct length
- > All cooling and heating channels are connected and tested for leaks
- Set automatic ladle, lubricators, etc.. (do after initial shots when tool condition is verified)

# Making the first sample run on a new Die Cast Die

The first sample run on a new die cast die, has one basic objective:

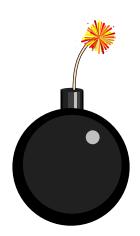
Simulate full Production conditions so die and castings can be properly evaluated without damaging the die.

Here are some guidelines for the first run of a new die:

- Preheat die to achieve at least 300 to 425 degrees Fahrenheit on the cavity surface: <u>heat penetration of cavities is essential for extended die life.</u>
- > Be sure all moving pins, slides, etc. are lubricated.
- Use anti-soldering paste only on hot dies to remove accumulated solder. Coating the cavity as a preventative measure may cause corrosion and clog up die vents.
- > Turn intensifier off.
- Use slow shot velocity to make the first shots.

<u>(Note:</u> For aluminum dies; some die casters make the first 6 to 12 shots with zinc to reduce thermal shock.)

- Using a well lit area or a flashlight to examine first shots for drags, undercuts, stuck pieces, and biscuit length.
- > Make additional shots while gradually adjusting the following:
  - Water Cooling Start with a trickle, gradually increase Fill die before 1st shot
  - Shot Velocity Start slow and gradually increase
  - Lock-Up May need to loosen as die gets hot
  - Dwell Time Start high, then gradually reduce using some judgment here as too long a dwell sometimes causes stuck pieces in cavity.
  - Die Spray Start with heavy application, then gradually reduce
  - After running for 15-20 minutes with no apparent mechanical problems, turn on intensifier.
  - Run die at normal production conditions for 1 to 2 hours, depending on size, to allow temperature stabilization and to permit proper evaluation of die performance and casting dimensions.
  - Once die is properly heated, it should be possible to keep castings after 3 shots.



# Watch Out For These Common problems with new dies



- ●<sup>™</sup> Shiny Cavity Surface-Promotes Soldering
- Soldering-Often Caused by Undersize Gate
- - Tight Ejector Pins Listen to the closing of the die
- Rough finish from EDM or incorrect polishing
- Tight Slide Gibs due to poor tapered or running fit

# Evaluation of First Run of New Die Cast Die

There is much to be learned during the first run of a die. It is important during this time to record as much information as possible to aid in the future running of the die.

Near the end of the sample run, all machine settings, including temperatures, should be tabulated on a set-up sheet. These settings will give you a starting point for future set-ups. In addition to recording these process settings, some observations need to be made. It is recommended that a questionnaire type form be used, similar to the one on the next page, which serves as a part of the die's permanent record.





# Sample Run Evaluation Sheet For Die Cast Dies

Custom	Die No.
Part No	Date
Built by	/ Sampled by
	Problems setting die up
	Problems getting die started
	LeaksWaterHot OilHydraulic
	Die operates smoothly
	Die ran continuously at production settings
	Die rates:Estimated RateRate Achieved
	Overflows and vents filled out
	Parting line flash
	Die spit?
	Casting filled out completely and stays on runner and overflow
	Casting dimensionally correct
	Casting internally sound
	Quality of parts acceptable to the customer
	Drags? Where?
	Soldering? Where?
	Die is ready for production. If not, what work should be done?
	Look for cracked die castings from first run
	Sticking vents
	Wall stock cast to machine or Wall stock raw casting.

# **II. PRODUCTION DIE CAST DIES**

### Proper Care for Longest Life

You have made a fabulous die design, purchased the best steel money can buy, custom heat treated the steel to achieve the ultimate properties, had the die built by your ace toolmaker and of course the gate and runner are just right. You have sampled it and got first piece approval (miracle of miracles!). Now you expect to get 1,000,000 to 3,000,000 shots off of it?

The following are some guidelines that, while they might not guarantee a million shots, have shown to be quite effective methods to maximize die life. These are tried and proven techniques being used by die casters and die shops throughout the world.

- 1. Always Preheat Never make a shot on a cold die. When preheating, do not overheat thin cores or thin steel sections. Preheat cavities to at least 300 to 425 degrees Fahrenheit by using a hot oil, gas, or electric means and measure with thermocouples in cavity.
- 2. Stress relieve at regular intervals....suggested every 20,000 to 30,000 shots. Other times to stress relieve are after initial sampling and after any die repair/change that includes welding, EDM, heavy grinding, or polishing. At the first sign of heat checking, polish out, stress relieve and consider MetaL\*ife® surface treating the die to close the heat checking and put the surface in compression.
- 3. Do regular die maintenance. This should include disassembling, cleaning, and visually inspecting the die. Look for signs of metal build-up on the parting line and in slide pockets. Repair peened and hobbed over areas. Draw polish problem areas, lubricate all moving parts and make sure all moving parts are free. Check shut-offs and locks, keep a die history, and coat face of die with protective coating. Complete Die Maintenance program is on page 17
- 4. Control die temperature, keep it as even as possible throughout die. Run cavities as hot as possible and still get a good casting. Use hot oil system when needed.

- 5. Control metal temperatures keep it as low as possible without jeopardizing casting quality.
- 6. Run die consistently. Eliminate interruptions and work stoppages which rapidly will cause loss of die temperature.
- 7. Be sure water lines are connected and some water is flowing before starting to run.
- 8. For long running jobs consider Metal<sup>\*</sup>ife<sub>®</sub>, Solvenite, or some other tested and approved type of surface treatment. This may be applied after sampling and at scheduled intervals to enhance the performance and extend the life of your die.
- To provide protection against thermal fatigue cracking, Metal \*ife® cavities when new (after sample approval) and again at specified intervals to maximize life expectancy.
- 10. <u>NEVER</u> use a torch to melt out stuck castings.
- 11. Try to eliminate all flashing on parting line or slides. Keep parting line clean.
- 12. Do not allow steel chisels and/or ejector pins with chisel points to be used by any die cast personnel. Use brass chisels.
- 13. Correct network heat checking before it develops into a gross cracking situation.
- 14. Run in correct size machine, with correct size shot sleeve and tip to achieve correct gate velocity and cavity pressure.
- 15. Reduce scrap as much as possible.
- 16. Take steps to minimize soldering which will reduce the need for repeated polishings.
- 17. Avoid any welding unless absolutely necessary. Follow NADCA "Welding <u>H-13 Die Cast Dies</u>" techniques when welding is required.
- 18. Perform the proper set-up procedures as discussed later in this section.

- 19. Utilize the proper application of die lubricant. This includes the correct choice of lubricant, proper dilution ratio, with a fine atomized spray. Do not overspray which can cause external cooling and lead to premature heat checking.
- 20. Consider adding bactericides to the die lubricant if tool is running in a warm or humid ambient environment.
- 21. Keep all moving parts well lubricated.
- 22. Allow no shims between die and platen or on parting line of die. Fix the problem!
- 23. Avoid over lock-up with excessive tonnage.
- 24. Consider using a vacuum system if pressure tightness or internal porosity is a problem.
- 25. The utilization of calculated metal flow is recommended to optimize fill conditions.
- 26. Avoid over extended hydraulic pressure, thus increasing the clamping tonnage required.
- 27. Do not use the "slam" approach to obtain quality castings. High shot velocities above that which are required will damage the tool.
- 28. Record gate thickness each run. Maintain at the desired height.

Care and maintenance must be considered during the design phase of building a die. It can save many hours of down time during the life of the tool.

It is helpful to include the people who maintain, handle, and install the die in the design phase. They are the ones who have to live with the die during production.

On the following page is a P/M program for die cast dies, submitted and used by Bob Hughes, of Supreme Tool & Die.

### ITEMS TO BE CONSIDERED FOR YOUR PREVENTATIVE MAINTENANCE PROGRAM

- 1) At the end of each run, completely tear down the die and inspect all components. Polish where required (Pounded P/L drags, etc). Replace worn, broken or bent core pins. Inspect all ejector pins. Lubricate the complete ejector assembly.
- 2) Stress relieve the cavities at 950 degrees F for 4 hours every 20,000 shots.
- 3) Inspect the leader pins and bushings. Replace as required.
- 4) Update date code pin as required.
- 5) Inspect gates for erosion. Correct and re-qualify as required.
- 6) If die is MetaL<sup>\*</sup>ife<sub>®</sub> treated, redo every 30,000 to 50,000 shots. If die is Solvenite treated, redo every 50,000 shots.
- 7) All tooling with annual shots of 20,000 or less should be stress relieved every year per item #1.
- 8) Draw polish all surfaces of the cavities.
- 9) Remove metal build-up from the holding frame and inspect for damage. Correct and requalify as required.
- 10) Remove, inspect, and correct as required all slides, cam pins, and locking heels. When the components are reset in the tooling, check for proper fit, pre-load, slide action, and lock interference.
- 11) Check support pillars. Replace or correct as required when proper pre-load is not present.
- 12) Recondition the holding frame at the time of cavity replacement.
- 13) Clean and polish gas vents as required.
- 14) Coat the die faces with a protective coating to prevent rust.
- **15)** Flush and/or drill out the water lines to remove Lime build-ups as per the water conditions existing.
- **16)** Chase water line threads to insure good seal.

- 17) Verify steel hardness every 25,000 shots.
- 18) Check holder blocks and ejector plates for flatness.
- **19)** KEEP A HISTORY OF EACH DIE.

# **Proper Set-Up of Production Dies**

### <u>Safety</u>

Safety is of prime consideration when performing set-ups. There are numerous potential safety hazards connected with the set-up process. A member of the set-up team must be conscientious and alert at all times during the set-up procedure.

One must use good common sense in performing the various functions of the set-up. Some specific safety items pertaining to set-up include:

- Use eye bolts and chains properly when lifting dies.
- Always be aware of the location of other individuals in the area.
- Routinely check all safety devices on the machine to insure proper operation.
- Keep area around machine clean.
- Make sure eye bolts are in each half of die, or, use safety straps to hold two halves together.
- Put machine on "inch" or "jog" control.
- Make certain shot is locked.
- If possible, adjust position of shop tip so that it blocks the pour hole. (This prevents accidental pours while die is being serviced)
- If more than one person is setting die, each must be aware of where the others are at all times.
- Eyebolts: OSHA approved and properly seated.
- Chain slings: Properly inspected and within weight limits.

- Chain hooks: Meet OSHA requirements with safety latch.
- Lock electrical panel with padlock
- Use mechanical safety bar

# The Set-Up Procedure

### Numerous tasks are performed in the course of a proper set-up.

Some suggestions that make your set-up more efficient include:

- > Organizing your set-up people into teams that use common methods.
- Make set-up procedure sheet, or check list for each die which begins with removal of previous die. These should be developed by set-up people.
- > When die is pulled, always keep a last shot casting and wire it to the die.
- > Last part trimmed should also accompany the trim die.
- > Assigning tasks on procedure sheet to various team members.
- > Have procedure sheet signed off by each person performing task.
- > Gathering all items necessary for set-up before shutting machine down.
- > Die cleaned, all water lines, hydraulic lines, and electrical circuits tested.
- > Moving parts lubricated before set-up.
- > Preheating the die before set-up if possible.
- > Standardizing your die clamps and bolts.

### Common Problems to Watch for

- ●<sup>™</sup> Bumper rods not same length.
- Platens not cleaned before set-up.
- Die halves not properly aligned.
- ▲ Area around machines left cluttered.
- Die not properly preheated.

- Main Improperly set limit switches
   ■
- Reciprocator not set up properly.
- ●<sup>™</sup> Ladle improperly set
- ●<sup>™</sup> Improper tip size and clearance

# Starting up a Production Die

Once a die has been sampled, approved, and made several production runs, there can be a tendency to treat future runs casually, or with less care and attention than a new die might receive.

For best results (longest die life, lowest scrap) the following guideline should be observed <u>every</u> time a die is set up to run.

- Preheat the die from 300 to 425 degrees Fahrenheit. Never make a shot on a cold die.
- > Check the following <u>before</u> making the first shot:



Use anti-

Machine lock up
Die alignment
Die temperature
Metal temperature
Shot velocity settings (Slow & Fast)
Proper alloy
Machine settings
Look for water, oil leaks
Water flow/or lack of
Are all safety devices working?
Is Die Cast machine's lube system to linkage working?
Ladle operation
Ladle size
Intensifier off
Good shot sleeve & tip
Dry cycle machine and die
Apply anti-solder compound to cavity if soldering is present Use soldering paste only on hot dies to remove accumulated solder.

Water lines are on trickle

- > Check the following <u>when</u> making the first shot:
- Have all people in the area stand clear.
- On problem dies, start by making a few shots with Zinc before making aluminum shots.
- When die and machine are up to production conditions, have first <u>good</u> piece approved by quality department.
- > Check the following <u>when</u> making Production Run:
- Run die consistently minimize stoppages.
- Never use an acetylene torch, or steel chisels to remove stuck castings.
- Correct problems at once even if it means pulling the die.
- Monitor the production process for drifting or changes and correct as required.
- > Other items to consider
- Include the trim die in set-up consideration and treat as "first line" gage.
- $\Box$  Die should be tagged with sign-off by the tool maker that hangs the tool.
- Feedback sheet should be passed back to the tool room from set-up team.

Use set-up parameters recorded on evaluation sheet during sampling (see p.12) or during last production run. This "set-up sheet" should record all machine settings, cold chamber size, and all temperatures. It should be reviewed and modified each time the die is run for greatest accuracy.

For the first shot of a run, all temperatures, and cold chamber size, should be to the set-up sheet, and the machine settings should be on the "soft" side. ie., Intensifier off, fast shot velocity at 50%. After three or four shots, these should be adjusted to production settings.







# **Evaluating the Performance of a Production Die**

# Die performance is measured by Day-to-Day Productivity and Overall Life of the Tool.

### Day-to-day performance can be categorized by the following criteria:

### Downtime

How much downtime is caused by the die? How many shots can be made before breakdowns or quality problems occur? Can the die be run consistently with no stuck parts, no build-up on parting line, no slide problems, no solder or fusion?

### Maintenance

No die will run forever without some amount of maintenance. It is always more desirable to perform regularly scheduled maintenance to prevent unscheduled downtime, than to run a die until you have a problem. It is a good idea to develop a repair order form and keep this with the tool file. Keeping records of "die caused" downtime will highlight the routine maintenance that needs to be done to a die. This work can then be scheduled at a convenient time, such as at the beginning of a shift, to prevent conditions from getting to the point of producing scrap.

### Quality of parts

One way to measure a die's performance is by examining scrap rate. Most scrap at die cast is for visual defects. Things to consider if scrap rate appears to be high:

Does everyone understand what quality standards are required? Quality standards sheet and/or marked castings will help.

Have quality standards changed since die was built?

Are you certain the defects are caused by the die or machine? Monitoring
devices can be used to determine if the machine is performing correctly.
Are you getting customer complaints?
Can improvements be made in the process to reduce scrap?
Can improvements be made in the <u>die</u> to reduce scrap? ie., venting, cooling, gating, ejection?
Can improvements be made in <u>part design</u> to reduce scrap? ie., thicken a wall, add a rib, increase draft, add fillet radii, consult customer?
SPC charting will assist in scrap evaluation.
Will vacuum help?
Will hot oil help?
Do you need more ejection? Internal or outboard?
If small core pins are breaking, should they be drilled?

### Productivity

Do your good shots per hour compare to what was quoted? Consider these points if they do not.

Is quote too high, or low?

Is machine performing correctly?

□ Can improvements be made to the tool?

such as: Added cooling, surface treatments, inserts of different die materials?



□ Can part design be changed? ie.,., add a metal saver, fillet radii?

Will hot oil help?

Ratio of shot wt. to part wt. - Do you have excessive remelt? Can this ratio be improved?

Assign and track life expectancy on perishable details and/or core pins. Replace at 85% of this predetermined life regardless of condition during scheduled or unscheduled maintenance.

<u>Overall Life of Tool</u> Life is usually measured by how many shots were made on the tool before it had to be removed from service. Some things to consider in this evaluation include:

- > How much maintenance was required to achieve this life?
- > How much scrap was generated-especially in the last run?
- Should die have lasted longer?
- What are the problem areas in the die? Can they be improved on when replacement cavities are built?

# Record Keeping

It is important to keep good records, preferably in a computer database, for proper evaluation of a tool. Records should include the following:

- > Each time routine maintenance is done to the tool
- > Each time welding is done to the tool
- Each time emergency maintenance is required, ie., stuck casting, broken die section etc.
- Each time a core or ejector pin is replaced (number the pins and record by pin number)
- Each time stress relieving is done
- > Each received customer complaint
- > Document the current die condition at end of each run
- Gating thickness and area

When building replacement cavities, all records should be reviewed to highlight areas where improvements are needed.

# III. WORN OUT DIE CAST DIES

### Evaluating the Condition of Worn Out Dies

<u>Dies do wear out!</u> Even with the best of care, a die cast die does not last forever. It will be less difficult to convince our customer that it's time to replace a cavity or a complete die if we maintain good records of monthly shot counts and tool condition. How do we know when a die is worn out?

Sometimes there is no question regarding the ability of a die to make another casting. A catastrophic failure could occur when a large chunk of cavity steel breaks out of a die, or a cavity breaks into several pieces due to gross cracking.

At these times when it becomes necessary to repair or replace a tool the die caster needs to answer the question *Are you satisfied with the number of shots that was obtained from the tool?* Was this condition expected or unexpected?

It is far better to vigilantly monitor the condition of each tool during its life and not be taken by surprise when a major failure occurs.

The following guidelines can be used for measuring the gradual deterioration of a die. These will allow you to monitor and document the die's condition throughout its life and to predict when major repair or replacement will be necessary.

### Visual Inspection:

- Last Shot check amount of heat check, drags, cracks, parting line flash, slide flash, bent/broken cores, ejector pin condition, fusion, ejector pin flash, broken out pieces, etc.
- Cavity and Cores check for heat check, cracks, fusion, broken out pieces, damaged cores, caved in parting line.
- Core Pins, should have a date etched on core heads for life expectancy reference.
- Holder Block condition of parting line, flatness, dents, craters, excessive flash, metal fused to parting line, condition of vents.
- Slides check for fit, metal build-up, fit of locks (when hot), condition of angle pin holes, excessive wear.
- Sibs, Angle Pins, Leader Pins check for excessive wear.
- > <u>Plates, Rails</u> check for flatness, bends, warps.

### Quality of Castings

- Are parts acceptable to customer?
- > Are dimensions becoming impossible to hold due to wear, die condition?
- > Do SPC charts of critical dimensions show a trend toward out of specification?
- Is amount of Heat Check objectionable?
- Are wall sections out of print specifications? This should be rectified the next time the die is tooled. Avoid welding to correct this if at all possible. Heavy walls mean you are shipping extra metal at extra cost.

### Production Cycle Time

Die Condition will affect cycle time in various ways, such as:

- > Must run slower due to water line cracks
- Excessive heat check causes drags, sticking, bending of parts
- Excessive washout causes drags, bending
- Excessive die lube required because of heat checking or washout can cause porosity, and stained castings.

### Rework of Castings

How much rework is required on parts due to die condition, ie., sanding of heat check, removal of ejector pin flash, removal of slide parting line flash, straightening of parts, drilling out of holes due to broken core pins?

### Maintenance Costs

Are maintenance costs becoming prohibitive, are they causing excessive downtime and/or scrap?

### <u>Scrap</u>

Is the amount of scrap generated by the die increasing due to die condition, ie., distorted castings, more warm-up shots required, excessive porosity, etc?

### Grading System - Tool Condition vs. Casting Quality

Tool Condition has a direct relationship to Casting Quality. A grading system with a short description of both the Tool Condition and corresponding Casting Quality has been supplied by Bob Hughes of Supreme Tool. This grading system can be helpful when discussing casting quality problems with die cast end-user customers. The column on the left shows the condition and state of the tooling. The column on the right gives the resulting casting quality that can be expected from this tool condition.

### **TOOLING CONDITION**

#### Excellent

New die and sample shots have been made. A small prototype lot may have been run, or die has just been started in production.

### Good

Die condition good. Productivity of die is good. Some minor heat checking is beginning to appear in gate area.

### <u>Fair</u>

Wear and wash is apparent on die surface both on cover and ejector inserts. Heat checking is minor, but is appearing on the entire die surface. Polishing of die surfaces required. Minor repairs must be made to die. Some die breakage can be expected in thin areas. Die deterioration will be more noticeable at sharp corners. Welding may be required in some areas to re-qualify critical areas. Critical dimensions or appearance surfaces will become a problem. Die inserts will require surface treatment at this point. Replacement inserts and die parts should be ordered.

### Poor

Heavy wash and heat checking appear on die surfaces. Cracking of the die inserts can be noticed. Cracks may extend into coolant lines causing leaks into cavity areas. Major repairs can be expected at any time. Productivity is down and scrap is high due to castings sticking in die and ejector pins breaking. Total failure can occur at any time. Die only capable of periodic production of non-cosmetic, non-critical castings.

### CASTING QUALITY

#### **Excellent**

Casting quality is good. Surface appearance is also good with no evidence of die deterioration. Detail of casting very good.

### <u>Good</u>

Quality of casting good. Surface Appearance is good, but slight gate wash and very minor heat check may be starting to appear in gate areas.

### <u>Fair</u>

Quality of casting surface both front and rear shows signs of heat check. Some loss of detail will be noticed due to increased amount of polishing. Flashing will now appear around ejector pin and core pin holes. Parting line deterioration will also be noticeable. Extra cost secondary operations may be required to sustain production.

### <u>Poor</u>

Casting appearance due to heat checks and die cracks is poor. Stains may appear on casting surface due to leaks in cavity area. Some hand work may be required to casting in order to produce an acceptable part due to appearance. Some machining to casting may be required to bring casting into specification. Customer to be responsible for added operations. Casting prices may have to be increased if replacement tooling has not been ordered. Parting line deterioration will be extensive.

#### <u>Unusable</u>

Cannot run die due to die condition (severely worn or broken die components).

# Squeezing More Runs Out of Worn Out Dies

It sometimes becomes necessary to do unwanted interim repairs to a tool to enable it to make another run. In this section we discuss various conditions found in worn out dies and some temporary fixes that can be made to allow an additional limited amount of production.

### <u>Severe Heat Check</u>: Listed in implied order of severity of fix:

- Resink cavity and shim back of cavity block
- Machine out problem area, weld, recut
- Insert problem area
- > Weld with maraging and Metale\*ife  $\$  and/or Solvenite the entire cavity wet area and runner
- Polish entire cavity and core then Metal\*ife® for crack closure and further fatigue protection by putting surface in residual compressive stress
- Solvenite or other surface coating

### Stress relieving should be done along with any of the above.

### <u>Gross Cracks</u> Listed in implied order of severity of fix:

- > Make separate insert for the problem area
- Machine out, weld, recut then Metal<sup>\*</sup>ife<sup>®</sup> process to stop further propagation of other network heat checks
- Bolt together and weld
- Stress relieve to stop propagation of cracks
- Reduce operating parameters and "limp" along at reduced speed if parts are acceptable to customer

Flashing Ejector Pins Listed in implied order of severity of fix:

- Insert area and make new holes
- Install sleeves and new pins
- Weld hole and resize
- > Open hole up to next size pin if possible
- Continue to run and remove flash from castings

<u>Relentless Fusion and Soldering</u> Listed in implied order of severity of fix:

Check design parameters ie., gate size, gate velocity, fill time, metal temp

- Try other die materials ie.,. Maraging steel, Anviloy 1105, TZM
- Make separate insert for the problem area
- Cut out problem area and weld

- Add more cooling to die
- Redirect metal flow in cavity
- Add draft in problem area
- ➢ MetaL<sup>\*</sup>ife<sub>®</sub> process
- > Solvenite process or other surface treatment
- Rocklinize surface
- Use Armor Kote surface coating
- Try different die lube
- > Try richer die lube
- > Check die cooling water lines plugged
- Polish cavity and stress relieve to form a protective oxide coating on die surface

### Leaking Water Lines

- > Weld crack
- Insert copper tube into waterline
- Retape threads
- > If due to a crack, use suction pump to draw water through line
- > Shut off water, increase spray, run slower
- > Use air instead of water and run slower but expect quality to suffer

### Flashing, Spitting P/L

- Recess cavities to allow holder block to shut off
- Blue in parting line may require welding of hobbed areas, grinding of parting line, reburning of parting line
- > Weld a "dam" in problem area
- Check machine alignment
- Check projected area vs. machine lock-up capacity
- Clean parting line
- Check size of vents
- Check sleeve size (larger diameter sleeve will reduce metal pressure)
- Install flash guard on die P/L

### Flashing Slides

- > Add gibs or wear plates of different material
- Weld problem areas and refit
- > Add taper to sides of slide (Pie shaped) to improve shut off
- > Shim face of slide to shut off tighter
- Shim slide lock to shut off tighter
- Use pre-squeeze
- Check sleeve size (larger sleeve will reduce metal pressure)

### Summary

NADCA would like to thank all members of the Die Care & Maintenance task force, die casting company employees, and die cast consultants who contributed in gathering, drafting, and analyzing the data presented in this publication.

By utilizing their extensive amount of knowledge, we have put together a useful publication that can be used as a reference by all die casters who desire to get longer tool life and improved performance from die casting operations.

This booklet, while inclusive, does not provide a complete listing of everything that can be done to care for die cast tooling. The material presented is meant to be used only as a foundation upon which to build a full die care maintenance program. It is with this belief, that these proven methods and ideas can make a difference for all die casters in some form.

Technological growth involves trying new and innovative methods and ideas. Die casters who share ideas and methods encourage progress that helps make all of us more competitive in future world markets. By keeping an open mind to these ideas, we can gain the wisdom that encourages us to successfully try them, thereby assuring continuing growth and a bright future for our industry and its products.

We trust this manual makes a difference in this area.

(Disclaimer)

Every effort has been made to ensure that the advice contained in this publication is accurate and safe. NADCA and its participants, however, accept no responsibility for injury, loss of revenue, or damage caused by use of the techniques described.

It is essential that all state and federal codes of practice concerning safety in manufacturing and environmental matters be fully and totally adhered to.