

Design of College Logo using Hand Injection Moulding process

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Abstract – Hand injection moulding is widely used in different sectors and organizations for the production of different types of logos. In this process different types of software's and machining process are used like Auto-cad, Master Cam, Pro-E and CNC, EDM and lathe machine for designing Logos. In the present work, the material is Mild Steel. Here we made college logo of dimension 100mm x 100mm having circular shape and dowel pins are of diameter 10mm and 12mm.

Key Words: Auto cad, Pro-E, Injection moulding machine, CNC, EDM, mild steel.

1. INTRODUCTION:

The injection moulding has seen steady growth since its beginning in the late 1800. The technique has evolved from the production of combs and buttons to major consumer, industrial, medical and aerospace products. In 1868, perhaps in response to a request by billiard ball maker Phelan and Colander, John Wesley Hyatt invented a way to make billiard balls by injecting celluloid into a mould. By 1872, John and his brother Isaiah Hyatt patented the injection moulding machine. The machine was primitive yet it was quite suitable for their purpose. It contained a basic plunger to inject the plastic into a mould through a heated cylinder. Revolutionizing the plastics industry in 1946, James Hendry built the first screw injection moulding machine with an auger design to replace Hyatt's plunger. The auger is placed inside the cylinder and mixes the injection material before pushing forward and injecting the material into the mould. Today, almost all injection moulding machines use this same technique.

1.1 HISTORY OF ROTATIONAL MOULDING:

Rotational moulding has had a long history of development dating back to the Egyptians who used rotational casting processes for creating ceramics. Moulding processes were used hundreds of years ago by the Swiss to make hollow chocolate eggs. In more recent times, somewhere between 1940 and 1950 in the USA, the rotational moulding process was developed for a small number of plastics but its popularity did not take off because it was regarded as a slow process. In the past few decades, however, process control improvements and plastic powder developments have resulted in a very large increase in its use. By the late 1950, when the process was better understood, applications for other industries were developed including road cones, marine boys, and care armrests. The Engel process was developed in Europe in the early 1960, that enables large

hollow containers to be created in low density polyethylene (LDPE) by rotating (or rocking) a mould on a chassis, houses open gas jets, through 30 degrees which coated the inside of the mould with the polymer. The cooling method was simply switching off the burners. This allowed the rocking to continue until the moulding could be extracted.

By the 1980, the rotational moulding process was streamlined by larger material suppliers around the world, and in response to increasing demand, new materials and grades became available. Storage tanks of all sizes and shapes typically dominated the industry in various compositions including polycarbonates, polyesters, polypropylene, LDPE, nylon and ABS (Acrylonitrile Butadiene Styrene) complemented LDPE and high density polyethylene (HDPE).

Today, the primary aspects attracting current research involve lowering the cycle times and improving the quality of parts. Pressurization techniques offer some hope in lowering the cycle times as applying a small pressure at the right point in the heating phase may speed the coalescence of polymer particles. This will produce parts with less bubbles in a shorter amount of time than at atmospheric pressure. Critics of the pressurization technique justify their position by pointing out the danger of explosion of pressurized parts; this is the reason mould pressurization has not yet been widely adopted.

1.2 MOULD:

It is an assembly consist of an impression, which is a recess or gap similar to the component form by the to mould members termed as 'CORE' and 'CAVITY', into which the molten plastic material is injected under pressure and is allowed to be cooled either by water or air till the component gets hard.

1.3 CAVITY:

It is female part of the mould, which gives the external of the component. Pockets, slots, holes are considered as Cavities. There are highly polished to a mirror finish, requires better finishing appearance on the outer surface of the component.

1.4 CORE:

It is male part of the mould, which gives the internal shape of the component. All projections are considered as cores. These are not required high polish as the component is to be sticks on to core.

2. PRINCIPLE AND PROCESS OF INJECTION MOULDING:

The process of injection moulding essentially consists of plasticizing the raw material in cylinder by the application of heat and then injecting it under pressure through a nozzle by means of a ram into a closed mould where it is allowed to cool and then operating the mould and removing the moulded component. There are two methods employed to inject the plastic material into the mould, one by means of plunger and another by means of a screw which transports the material during which the time it is plasticized and then it is injected.

2.1 MACHINE USED IN HAND INJECTION MOULDING:

There are various types of machine that are used during the preparation of hand injection mould. Those are as follows:

2.1.1 POWER HACKSAW:

Power hacksaws are used to cut large size (sections) of metals such as steel. Cutting diameters of more than 10/15mm is very hard work with a normal hand held hacksaw. Therefore power hacksaw have been developed to carry out the difficult and time consuming work. The heavy 'arm' moves backwards and forwards, cutting on the backwards stroke.

The metal to be cut is held in a machine vice which is an integral part of the base. Turning the handle tightens or loosens the vice. The vice is very powerful and locks the metal in position. When cutting is taking place, the metal and especially the blade heats up quickly. Coolant should be fed onto the blade, cooling it down and lubricating it as it cuts through the metal. Blades of power hacksaws are graded according to the material they are made from and the number of teeth per inch. Top quality blades are manufactured from High Speed Steel. Although there is cheaper alternative such as carbon steel blade in general the number of teeth per inch (TP) ranges from 14 to 24 more teeth per inch for the smoother cut.

2.1.2 MILLING MACHINE:

A milling machine is a machine tool used to machine solid materials. Milling machines are often classed in two basic forms, horizontal and vertical, which refer to the orientation of the main spindle.

Both types range in size from small, bench-mounted devices to room-sized machines. Unlike a drill press which holds the work piece stationary as the drill moves axially to penetrate the material, milling machines also move the work piece radial against the rotating milling cutter, which cuts on its sides as well as its tip. Work piece and cutter movement are precisely controlled to less than 0.0001 in (0.025 mm), usually by means of precision ground slides and lead screws or analogous technology. Milling machines may be manually operated, mechanically automated, or digitally automated via computer numerical control (CNC).

Milling machines can perform a vast number of operations, from simple (e.g., slot any keyway cutting, planing, and drilling) to complex (e.g., contouring, die sinking). Cutting fluid is often pumped to the cutting site to cool and lubricate the cut and to wash away the resulting scarf.

2.1.3 GRINDING MACHINE:

The grinding machine consists of a power driven grinding wheel spinning at the required speed (which is determined by the wheel's diameter and manufacturer's rating, usually by a formula) and a bed with a fixture to guide and hold the work-piece.

The grinding head can be controlled to travel across a fixed work piece or the work piece can be moved whilst the grind head stays in a fixed position. Very fine control of the grinding head or table's position is possible using a vernier calibrated hand wheel, or using the features of numerical controls.

Grinding machines remove material from the work piece by abrasion, which can generate substantial amounts of heat; they therefore incorporate a coolant to cool the work piece so that it does not overheat and go outside its tolerance. The coolant also benefits the machinist as the heat generated may cause burns in some cases. In very high-precision grinding machines (most cylindrical and surface grinder) the final grinding stages are usually set up so that they remove about 200 mm (less than 1/100000 in) per pass – this generates so little heat that even with no coolant, the temperature rise is negligible.

2.1.4 COMPUTER NUMERICAL CONTROL MACHINE:

Most CNC milling machines or machining centers are computer controlled vertical mills with the ability to move the spindle vertically along the Z-axis. This extra degree of freedom permits their use in engraving applications, and also allows creating 2.5D surfaces such as relief sculptures. When combined with the use of conical tools or a ball nose cutter, it also significantly improves milling precision without impacting speed, providing a cost-efficient alternative to most flat-surface hand-engraving work. CNC machines can exist in virtually any of the forms of manual machinery, like horizontal mills. The most advanced CNC milling-machines, the 5-axis machines, add two more axes in addition to the three normal axes (XYZ). Horizontal milling machines also have a C or Q axis, allowing the horizontally mounted work piece to be rotated, essentially allowing asymmetric and eccentric turning. The fifth axis (B-Axis) controls the tilt of the tool itself. When all of these axes are used in conjunction with each other, extremely complicated geometries, even organic geometries such as a human head can be made with relative ease with these machines. But the skill to program such geometries is beyond that of most humans. Therefore, 5-axis milling machines are practically always programmed with CAM. With operating systems such as Linux, and open

source CNC software, the entry price of CNC machines has plummeted. For example, Shoreline, Prize, and others make desktop CNC milling machines that are affordable by hobbyists.

2.1.4.1 TOOL USED IN CNC MACHINE:

There is some degree of standardization of the tooling used with CNC Milling Machines and to a much lesser degree with manual milling machines. CNC Milling machines will nearly always use SK (or ISO), CAT, BT or HSK tooling. CAT tooling, sometimes called VF Lange Tooling, is the oldest variation and is probably still the most common. CAT tooling was invented by Caterpillar Inc. of Peoria, Illinois in order to standardize the tooling used on their machinery. CAT tooling comes in a range of sizes designated as CAT-30, CAT-40, CAT-50, etc. The number refers to the NMTB Taper size of the tool.

An improvement on CAT Tooling is BT Tooling, which looks very similar and can easily be confused with CAT tooling. Like CAT Tooling, BT Tooling comes in a range of sizes and uses the same NMTB body taper. However, BT Tooling is symmetrical about the spindle axis, which CAT tooling is not. This gives BT tooling greater stability and balance at high speeds. One other subtle difference between these two tool holders is the thread used to hold the pull stud. CAT Tooling is all imperial thread and BT Tooling is all Metric thread. Note that this affects the pull stud only, it does not affect the tool that they can hold, both types of tooling are sold to accept both imperial and metric sized tools. SK and HSK tooling, sometimes called "Hollow Shank Tooling", is much more common in Europe where it was invented than it is the United States. It is claimed that HSK tooling is even better than BT Tooling at high speeds. The holding mechanism for HSK tooling is placed within the (hollow) body of the tool and, as spindle speed increase, it expands, gripping the tool more tightly with increasing spindle speed. There is no pull stud with this type of tooling. The situation is quite different for manual milling machines there is little standardization. Newer and larger manual machines usually use NMTB tooling. This tooling is somewhat similar to CAT tooling but requires a drawbar within the milling machine. Furthermore, there are a number of variations with NMTB tooling that make interchange ability troublesome. Two other tool holding systems for manual machines are worthy of note.

2.1.4.2 END MILLS:

Both the side and the end of an end mill can cut. They are available in different styles. They are as follows:

- 2 Flute
- 3 Flute
- 4 Flute
- 6 Flute

- Ball end, for cutting rounds and doing 3D CNC surfacing.
- Corner-rounding, for rounding corners.
- End mills are available in different lengths also they are given below:
- Stub, a good idea when using a small diameter cutter if the work piece is not very thick.
- Standard.
- Long, for reaching into deep cavities.
- Extra long, for reaching into extra deep cavities.

You should always use the shortest end mill available that will cut the geometry you need. Long and extra-long end mills may leave a relatively poor surface finish because they are prone to chatter and can break easily. Ask a TA for advice when a long end mill seems necessary. Available end mill sizes depend on style and length they are given below:

- 2 Flute standard end mills are manufactured in 1/64" increments down to 1/16" diameter.
- Ball end mills available in 1/32" increments down to 1/16" diameter.
- Because small end mills break so easily, the machine shop will typically stock down to 5/16" diameter end mills. We sell 1/4", 3/16", 1/8", 3/32", and 1/16" in standard and long lengths.

End mills are either centre cutting or non-centre cutting. Before plunging into a part with an end mill, check the end teeth to see if it is centre cutting. If the teeth meet at the centre, it is OK to plunge. If they don't meet, don't plunge with it.

2.1.4.3 SLITTING SAWS:

- Used for general slotting or cut-off operations.
- Available down to 0.0006" thick (thin).
- Because slitting saws break easily, the machine shop has a limited stock. Find out what's available.
- Get assistance before cutting.

2.1.4.4 SINGLE LIP CUTTERS:

Custom made cutters for special applications: in our shop they are typically ground for putting draft angles onto casting patterns. If you need something specific, you may need to make your own, so ask the staff for advice and refer

to the Single Lip Cutter Grinder document in the TA Handbook.

2.1.4.5 FLY CUTTERS:

- Used for taking light face cuts on large surfaces.
- Max depth of cut depends on material being cut
Steel: don't fly cut Aluminum, Brass: 0.025" max.

Plastic: 0.010" – 0.050" (be careful with plexus glass, the edges will chip with too heavy a cut).

2.1.4.6 EDGE FINDER:

An edge finder is used to locate the machined edge of a work piece. The edge finder is made of a shank with a floating tip retained by an internal spring. Mount edge finder in collet or drill chuck. Set spindle speed to 1000 RPM. Slide tip off-centre.

- Turn spindle on. Raise the knee or lower the quill to bring the edge finder tip adjacent to the work piece.
- Slowly move along the x-axis or y-axis to make contact between the edge finder tip and the edge of the work piece.
- Continue to slowly advance the work piece toward the edge find tip. As soon as the tip jumps sideways, Stop feed or you will break the edge finder.
- The spindle is now positioned 1/2 tip diameter off of the edge of the work piece. (Diameter = 0.200", so offset = 0.100").
- Lower the work piece or raise the quill until the tip of the edge finder is above the work piece.
- Now advance the table 1/2 tip diameter (0.100") farther to bring the spindle directly over the edge of the part. Set the DRO to zero.

2.1.4.7 DIAL INDICATOR:

Dial indicators, also known as dial gauges and probe indicators, are instruments used to accurately measure small linear distance, and are frequently used in industrial and mechanical processes. They are named so because the measurement results are displayed in a magnified way by means of a dial. A special variety of the dial indicator is the dial test indicator (DTI) which is primarily used in machine setups. The DTI measures displacement at an angle of a lever or plunger perpendicular to the axis of the indicator. A regular dial indicator measures linear displacement along that axis. Dial indicators may be used to check the variation in tolerance during the inspection process of a machined part, measure the deflection of a beam or ring under laboratory conditions, as well as many other situations

where a small measurement needs to be registered or indicated. Dial indicators typically measure ranges from 0.25 mm to 300 mm (0.015 in to 12.0 in), with graduations of 0.001 mm to 0.01 mm (metric) or 0.00005 in to 0.001 in (imperial).

2.1.4.8 DRILLING:

- Twist drill sizes less than 1/2" diameter are called out by Fraction: in 1/64" increments <Number: to fill in the spaces between fractional sizes 1/4"

Letter: to fill in the spaces from 3/16" – 7/16"

Metric: ask about availability.

- Our drill chucks will hold twist drills <1/2".
- The chuck should grab onto the drill's shank, not its flutes.
- Larger drill bits are available in fractions at 1/32" increments.
- Most of the larger bits have tapers that fit into tapered sockets.

When drilling or reaming of holes on the mill, straight-shank tools with diameters less than 1/2" are mounted in a mill drill chuck. Large straight-shank tools mount directly into collets. Large tapered drill bits are mounted into tapered sockets.

2.1.5 ELECTRIC DISCHARGE MACHINING (EDM):

Electric discharge machining (EDM), sometimes colloquially also referred to as spark machining, spark eroding, burning, die sinking or wire erosion, is a manufacturing process whereby a desired shape is obtained using electrical discharges (sparks). Material is removed from the work piece by a series of rapidly recurring current discharge between two electrodes, separated by a dielectric liquid and subject to an electric voltage. One of the electrodes is called the tool-electrode, or simply the 'tool' or 'electrode', while the other is called the work piece-electrode, or 'work piece'.

When the distance between the two electrodes is reduced, the intensity of the electric field in the volume between the electrodes becomes greater than the strength of the dielectric (at least in some point(s), which breaks allowing current to flow between the two electrodes. This phenomenon is the same as the breakdown of a capacitor (condenser) (see also breakdown voltage). As a result, material is removed from both the electrodes. Once the current flow stops (or it is stopped depending on the type of generator), new liquid dielectric is usually conveyed into the inter-electrode volume enabling the solid particles (debris) to be carried away and the insulating properties of the dielectric to be restored. Adding new liquid dielectric in the

inter-electrode volume is commonly referred to as flushing. Also, after a current flow, a difference of potential between the two electrodes is restored to what it was before the breakdown, so that a new liquid dielectric breakdown can occur.

3. METHODS AND MATERIAL:

3.1 HAND INJECTION MOULDING MACHINE:

Injection Moulding Machine is used to convert different types of plastic materials into useful items such as automotive components, household items, pens, medical items, marine components, toys, machine parts and medicine bottles etc. In this process predetermined quantity of heated and plasticized material is injected into mould under pressure and it solidifies before mould under pressure is similar to pressure die-casting. There are different types of machines, which are used to process different types of plastic materials such as hand operated, Cylinder and Ram type, Screw and Barrel type, hydraulically operated etc. Manually operated machine is used for cottage industries for manufacturing plastic components having weights from 15 to 50 grams. The main components of conventional hand operated machine are plunger and barrel, band heater, regulator, nozzle, system to applying force on plunger to inject plastic material into mould, mould and clamping arrangement to clamp the mould. There are different types of systems which are used for applying force on plunger to inject the molten plastic material into mould, such as rack and pinion arrangement, second class lever arrangement and screw and nut arrangement.

A conventional hand operated injection moulding machine is shown in Fig.1, in which rack and pinion arrangement is used to applying the force to inject the plastic material into mould. In this arrangement a rack is attached to plunger and a pinion is meshed with the rack. A handle is provided on pinion shaft to rotate the pinion. When pinion rotates rack moves up or down according to the direction of rotation of the pinion. The rack is moved downward for applying the force on the plunger which pressurizes the material through plunger resulting the injection of heated plastic material into mould cavity. After solidification of the material in the mould, rack moves in upward direction to release the pressure and after that mould is opened to remove the product from mould. The nut and screw system is also used for pressurizing the plastic materials, in which nut is kept fixed and screw is rotated with the help of a wheel or handle mounted on the screw, resulting up or down movement of screw according to the direction of rotation of screw. A plunger is attached on the lower end of this screw. A second class lever system is also used for pressurizing the material through plunger, in which the one end of the handle is hinged, plunger is attached in the middle of the handle and force is applied on free end of the handle. Researchers are being carried out for improving the performance of manually operated machines.

3.2 RAW MATERIAL:

Material: Mild Steel.

Tool Material: High Speed Steel, Carbide, SiO₂, Abrasive.

If we take a metal sheet of mild steel of 220mm/mg and 110mm width and 2 heights. To avoid the tilting of metal sheet we debar each sharp corner of the metal sheet. It is also necessary for the safety fiction point of view. Then we prepare the metal sheet of required dimensions with the help of milling operation.

3.3 SPEED LIMIT:

Speed is depending upon the material of the tool and work piece which we use in operation.

In this operation we use work piece as mild steel (ms) and material as tool as high speed steel (HSS).

For this speed of the spindle OS = 20-25 m/min (cutting tool-HSS, Work Piece (ms).

And rpm is calculated by the give formula

$$RPM = \frac{C.S \times 100}{\pi \times D}$$

Where,

C.S = cutting speed

D = Dig of the tool

If the diameter of the tool is 80 mm

$$RPM = \frac{22 \times 100}{\pi \times 80} = 87.5 \text{ rpm}$$

3.4 COOLENT:

Coolant is used to reduce the heat, which is generated in between tool and work piece. It also wears and tears of the tool material.

Coolant used

Servo-68, paraffin lubrication is used in the ratio of 20:1 in which 20% is water and 1% coolant.

3.5 MOTOR USED:

There are two types of motor is used in the machining system (operation).

1. Servo motor
2. Induction motor

Servo motor

It is used axis movement (x, y, z) and spindle rotation.

Introduction Motor

It is used to coolant flow in out and lubrication.

3.6 CNC MILLING MACHINE:

Specification:

BFW (Surya-1)

CNC vertical milling m/c – Fanuc series, 01 – meter series

Make – BFW (Bharat fritz Werner ltd)

Price = 18.2 lac.

X, Y, Z = 800 x 350 x 380

Accuracy = 10 Micron

3.6.1 Procedure of CNC Milling Machine

1st we fixed the vice on the bed of the CNC milling m/n. Then we fixed the metal piece (100 x 100 mm) on the vice and clamped it on the vice. By the use of soft hammer we properly fixed the metal on the vice. Then we use the dial indicator to check the flatness of the metal piece which is already fixed on the vice.

Lastly by the use of edge finder we find the centre of the material or work piece. Then after cutting operation will be start.

3.6.2 OPERATION OF CNC MACHINE:

1st operation is roughing:

We use the roughing tool (slot drill) of diameter 4mm of carbon material for pocketing purpose.

2nd operation is side finishing:

In this operation we use slot drill of diameter 1.5mm for side finishing of the work piece, and cutting material used in the process is carbide.

3rd operation is engraving:

In this operation we use the single leaf cutter of 6x30°. It is used for lettering.

3.7 CNC PROGRAMMING:

By use of master CAM software we prepare the required programming for roughing, side finishing and lettering. Following are the codes that are used in CNC programming. There two types of codes that are used in CNC programming G – Codes & M- Code.

SOFTWARE USED:

There are three kinds of software we are used in our project they are as follow:

AUTO Cad, Master CAM, PRO-E

4. DESIGN:

4.1 Design in Auto-CAD



Fig-1

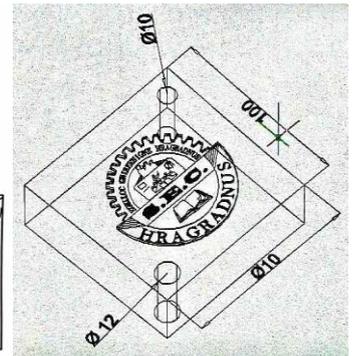


Fig-2

4.2 Design in Pro-E



Fig-1

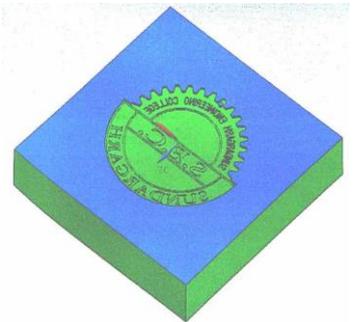


Fig-2

4.3 Design in Master- CAM



Fig-1

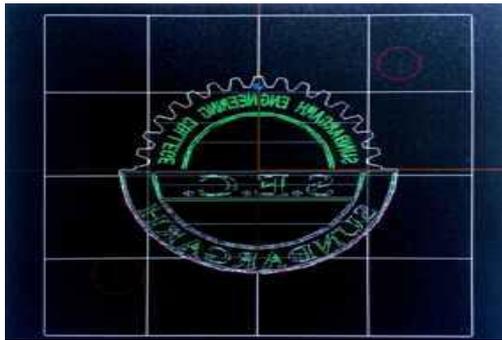


Fig-2

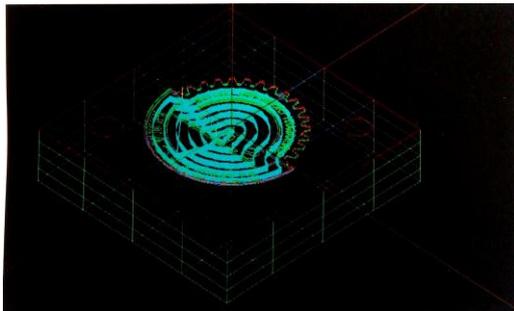


Fig-3

5. RESULTS:



Fig-1

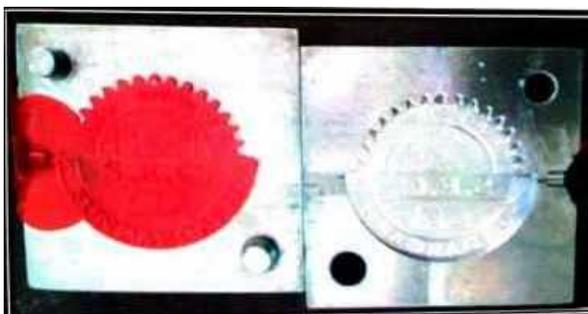


Fig -2 Final Product

6. CONCLUSIONS:

- ✓ The hand injection mould is plays a vital role in today technology era. Because plastics material are used everywhere without plastic material any useful work cannot be done easily at low cost.
- ✓ We done project on hand injection mould of college logo by using different types of conventional machine (Power hacksaw, Milling, Grinding, Lathe, CNC milling Lathe, Hand injection moulding machine etc.) and nonconventional machine (Electro Discharge Machine).
- ✓ We also use software like AUTO Cad 2010, PRO-E, and Master CAM in our production of mould. Where we learn to operate different types of software and machine and also we learn team management and time management.

REFERENCES

- [1] D. Kornack and P. Rakic, "Cell Proliferation without Neurogenesis in Adult Primate Neocortex," Science, vol. 294, Dec.2001, pp.2127-2130, doi:10.1126/science.1065467.
- [2] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.
- [3] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.
- [4] K. Elissa, "Title of paper if known," unpublished.

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