BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	**)**	
	)	
PROPOSED AMENDMENTS TO	**)**	
EXEMPTIONS FROM STATE	**)**	
PERMITTING REQUIREMENTS	**)**	
FOR PLASTIC INJECTION MOLDING	**)**	**R 05 -20**
OPERATIONS	**)**	
(35 Ill. Admin. Code 201.146)	**)**	

PRE-FILED TESTIMONY
ON BEHALF OF THE
CHEMICAL INDUSTRY COUNCIL OF ILLINOIS

In response to questions posed at the first hearing in this matter on July 1, 2005, CICI is herewith providing certain requested information. CICI witnesses, Lynne Harris, Lisa Frede, and Patricia Sharkey, will be present to answer questions regarding these responses at the July 15, 2005 hearing in Springfield.

1. Size of Facilities Exempted Under This Proposal

At the July 1, 2005 hearing, the Board asked how many PIM machines may be located at a given PIM facility. CICI has not found any studies or data directly addressing this question. However, CICI can state that its member facilities have between 4 and 70 machines.

Because the size of PIM machines varies, resin throughput is a better indicator of the volume of emissions associated with a given facility. CICI member facilities have annual PIM resin throughput ranging from 100 tons/yr to 3,250 tons/yr. Average facility annual PIM resin throughput is approximately 500 tons/yr.

2. Estimated Volume of PIM Emissions Statewide in Illinois.

The Board asked what volume of emissions would be exempt from permitting under this exemption. A broad estimate of the total volume of emissions generated by PIM processes statewide can be derived by first multiplying the number of facilities in Illinois by the average volume of resin processed per facility, and then multiplying that number by an appropriate emission factor. As indicated in Mr. Harris' testimony, a worst case VOM emission factor is 0.4 lb/ton of resin processed. If we add to that a worst case emission factor of 0.4 lb/ton of resin processed for the use of release or cleaning agent, as discussed in Section 5 below, we arrive at a conservative overall VOM emission factor of 0.8 lb/ton of resin used.

Using the above information and the previous testimony that approximately 500 PIM facilities are located in Illinois, the formula for calculating statewide VOM emissions associated with PIM is as follows:

500 facilities	X	500 tons resin /yr	=	250,000 tons resin /yr
250,000 tons/yr	X	0.8 lb VOM /ton resin	=	100 tons VOM /yr

CICI believes *100 tons per year* is a reasonable worst case estimate of the total volume of VOM emissions generated statewide by PIM facilities in Illinois. We note that this equates to *0.2 tons of VOM emissions per facility per year*. We further note that not all of the approximately 500 PIM facilities in Illinois will be exempted from state permitting under the proposal in this rulemaking. In response to the Board's question regarding the number of PIM facilities that have no other processes, such as coating, SPI did a rough survey of its members and determined that approximately 80% of its members in the PIM industry do not perform other processes at the their facilities. This indicates that around 20% of the approximately 500 Illinois PIM facilities will not be covered by this exemption. Thus total statewide emissions of VOM covered by this exemption are actually likely to be on the order of 80 tons per year.

To answer any concern the Board may have that there may be larger volumes of emissions involved, CICI has proposed in its Second Errata Sheet to limit the proposed exemption to PIM facilities with no more than 5,000 tons/yr of resin processed. If every facility in Illinois processed 5,000 tons of resin per year (an extraordinary assumption), the total VOM emissions subject to this exemption would be 1,000 tons/yr. That equates to approximately 2 tons of VOM per year per facility.

3. Location of PIM facilities in Illinois (Attainment Areas/ Non-Attainment Areas)

The Board asked about the location of PIM facilities in the State and whether they were primarily located in Attainment or Non-Attainment Areas. To answer this question, CICI reviewed the locations of the Illinois facilities listed in the Plastic News "2005 Survey of North American Injection Molders" and the locations of CICI member facilities, and determined that 14% of those PIM facilities are located in Attainment Areas and the remaining 86 % are located in Non-Attainment Areas. Of those located in Non-Attainment Areas, all are located in areas which have been designated as Moderate NAA under the new 8-hour ozone standard.

4. Estimated Emission from Resin Handling Operations: Loading, Unloading, Conveying, Storage, Mixing, Grinding, Drying

As indicated at the July 1st hearing, CICI has attempted to find studies and other sources of information on the volume and type of emissions generated by the various activities associated with resin handling operations. We have found no studies directly addressing or quantifying emissions from these activities. This is actually not surprising. As indicated in Mr. Harris' June 16, 2005 Pre-Filed Testimony, emissions from the injection molding process as a whole had not been quantified prior to 1996. This lack of quantitative information on emissions may also be explained by the nature of the materials involved and the process. The resin and scrap are hardened plastic material at ambient and low temperatures. Furthermore, these ancillary activities operate under negative pressure, thus emissions from the movement of resin, the drying of the resin and the grinding of scrap plastic are largely, if not entirely, drawn back into the process.

The following information on how and where emissions are formed in this process may assist the Board in understanding that emissions from these ancillary activities are minimal.

a. VOM and HAP Emissions

VOM and HAP emissions from plastic resin are directly related to temperature. As found in the SPI studies accompanying Mr. Harris' Pre-Filed Testimony (Group Exhibit 3), "emission rates are directly correlatable with the melt temperature of the resin involved." (Group Exhibit 3, Harris Exhibit 3, p. 56.) Thermoplastic resins have melt temperatures in the range of 300 F – 600 F. (Group Exhibit 3, Harris Exhibits 3 – 6.) The SPI studies demonstrate that even at the melt temperatures reached in the extruder screw VOM and HAP emissions are low. Thus, the brief drying of the resin at far lower temperatures to remove moisture from the pellets can be presumed to generate only a fraction of those emissions. The ancillary resin loading, conveyance and mixing at ambient temperatures can be presumed to be even lower.

To a varying degree, all plastic resins take on moisture when exposed to relative humidity. Even a minimal amount of moisture in many plastics can negatively affect molding characteristics. Dryers operated at low temperatures are often utilized to remove such moisture from plastic resin prior to the plastic injection molding process. The dryers blow heated ambient air over the plastic resins. The temperatures used for drying plastic resins are generally less than one half of the melting temperature of the plastic resin involved. (See attached Table 5.1 from the *Modern Plastics Handbook*.) Although CICI has not been able to find any data on emissions from dryers, emissions of VOM from plastic resin at the relatively low temperatures used in the drying process can be presumed to result in a small percentage of VOM or particulate emissions generated by the overall process.

The conclusion that VOM emissions from resin pellets handled at ambient temperatures are minimal is confirmed by the polyethylene study (Group Exhibit 3, Harris Exhibit 5) which measured emissions of VOC from the hopper area and found that emissions from this area accounted for less than 2% of the total VOCs measured. (Id., p. 577.)

b. Particulate Matter Emissions

There is an assumption that the movement of resin, even at ambient temperatures, generates some level of particulate matter ("PM"). However, CICI has been unable to find any EPA or industry studies of this subject.

To provide the Board with some perspective on the level of PM present at a PIM facility, CICI Regulatory Affairs Director Lisa Frede visited one of its member facilities on July 7, 2005. Ms. Frede will provide testimony at the July 15, 2005 hearing that she found it to be exceedingly clean, with no dust or film on the floor or the equipment, including the grinder or granulator, which is presumed to be the piece of equipment most likely to produce PM. She will also testify that none of the employees in this workplace wear respiratory protection, indicating the indoor particle levels meet OSHA standards without such protection. One of the primary reasons that PM is so low in these facilities is that product specifications require that foreign material not enter the process. Another reason is that injection molding and the associated resin and scrap handling are almost entirely enclosed operations which take place under negative pressure.

Ms. Frede will provide photographs and her observations on the injection molding process. (See attached Photos Nos. 1 – 9.) As can be seen from the attached photographs, the resin is brought to the machine in a cardboard “gaylord” box and fed via vacuum hose into the dryer and the hopper. The screw extruder and the mold are entirely enclosed processes. When the mold opens, the product drops on to an open conveyor belt, which can be seen to have little or no dust on it. Ms. Frede will testify that the plastic product and plastic scrap leaving the mold are extremely clean. The scrap plastic “runners” and “sprus” are removed from the mold by way of a robotic arm which drops the scrap into the grinder or granulator. As can be seen from the attached photos, the grinder area has little or no dust. Again, this is because the grinder operates under negative pressure and both the scrap plastic and any associated dust are drawn into the grinder. Closing the loop, the granulated plastic, while somewhat dusty, is fed directly from the grinder back to the hopper to be reused in the process. This takes place by way of a vacuum hose. Thus, the granulated plastic is never exposed to ambient air.

Given the fact that these processes are so clean, there is little likelihood that PIM machines would be vented outside the workplace. CICI's survey of its member facilities indicates that none of those facilities vent PIM machines outside the workplace. Thus there is little likelihood of PIM emissions entering the outside environment. To the extent that a PIM facility has emissions of concern within the workplace, they are subject to OSHA standards and are not regulated under the Environmental Protection Act or air pollution control permits issued under the Board's rules.

At the July 15, 2005 hearing, Ms. Frede will be happy to answer any questions regarding her observations at this facility. CICI will also provide samples of a typical resin, typical "runner" and granulated scrap, and a typical PIM plastic product which Ms. Frede observed being handled and processed at this facility.

5. Mold Release Agents and Cleaning Agents

Mold release agent and/or mold cleaner are sometimes used in the plastic injection molding (PIM) process. Mold release agent leaves a very thin layer of a "non-stick" substance on the surface of the mold to help parts fall from the mold as it opens at the end of the cycle. Mold cleaner is used to remove built-up residue from the mold surface. Some CICI member facilities have designed their molds to avoid use of mold release altogether, but still use mold cleaner.

Historically, the volatile organic matter content of aerosol mold release agents and mold cleaning products was in excess of 90%. However, mold release agents and mold cleaning products are now available in water-based formulations and in formulations that utilize non-photochemically reactive chemicals as carrier solvents.

Both mold release agent and mold cleaner are generally used in 12- 16 ounce aerosol cans. Based on data collected from CICI member facilities, VOM emissions from mold release agent and/or mold cleaner range from less than 0.1 lbs/ton of resin processed up to 0.4 lb/ton of resin processed. The combined usage of mold release agents and mold cleaner at a PIM facility can be conservatively estimated to generate 0.4 lbs of VOM per ton of resin processed.

In general, facilities try to design molds to minimize the use of mold release agents and mold cleaner because it is very inefficient to stop the PIM machine periodically to apply either release agent or cleaner to the mold. Well-designed molds require only a minimal amount of either substance. When possible, facilities try to apply mold release agent or mold cleaner only at the beginning of a production shift.

6. Definitions of "Compression Molding" and "Transfer Molding"

In response to a question from the Board, CICI is providing the following definitions which appear on The Society of the Plastics Industry, Inc. ("SPI") website at http://www.plasticsindustry.org.:

> **"Compression molding** is the most common method of forming thermosetting materials. It is not generally used for thermoplastics.
>
> "Compression molding is simply the squeezing of a material into a desired shape by application of heat and pressure to the material in a mold.
>
> "Plastic molding powder, mixed with such materials or fillers as woodflour and cellulose to strengthen or give other added qualities to the finished product, is put directly into the open mold cavity. The mold is then closed, pressing down on the plastic and causing it to flow throughout the mold. It is while the heated mold is closed that the thermosetting material undergoes a chemical change which permanently hardens it into the shape of the mold. The three compression molding factors -- pressure, temperature and time the

> mold is closed -- vary with the design of the finished article and the material being molded."
>
> "**Transfer molding** is most generally used for thermosetting plastics. This method is like compression molding in that the plastic is cured into an infusible state in a mold under heat and pressure. It differs from compression molding in that the plastic is heated to a point of plasticity before it reaches the mold and is forced into a closed mold by means of a hydraulically operated plunger.
>
> "Transfer molding was developed to facilitate the molding of intricate products with small deep holes or numerous metal inserts. The dry mold compound used in compression molding sometimes disturbs the position of the metal inserts and the pins which form the holes. The liquefied plastic material in transfer molding flows around these metal parts without causing them to shift position."

As stated in the first hearing, CICI is no longer proposing that these processes be included in the proposed exemption and does not plan to provide additional testimony regarding these processes.

Dated: July 11, 2005

Respectfully submitted,

CHEMICAL INDUSTRY COUNCIL OF ILLINOIS

By: /s/ Patricia F. Sharkey________
One of its Attorneys

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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

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OPERATIONS	**)**	
(35 Ill. Admin. Code 201.146)	**)**	

NOTICE OF FILING

TO: Ms. Dorothy M. Gunn
Clerk of the Board
Illinois Pollution Control Board
100 West Randolph Street
Suite 11-500
Chicago, Illinois 60601
(VIA ELECTRONIC FILING)

(PERSONS ON ATTACHED SERVICE LIST)

PLEASE TAKE NOTICE that on July 11, 2005, I filed with the Office of the Clerk of the Illinois Pollution Control Board by electronic filing the SECOND ERRATA SHEET and PRE-FILED TESTIMONY ON BEHALF OF THE CHEMICAL INDUSTRY COUNCIL OF ILLINOIS, a copy of which is hereby served upon you.

Dated: July 11, 2005

Respectfully submitted,

CHEMICAL INDUSTRY COUNCIL OF ILLINOIS

By: /s/ Patricia F. Sharkey______
One of its Attorneys

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CERTIFICATE OF SERVICE

I, Patricia F. Sharkey, an attorney, hereby certify that I have served the Second Errata Sheet and Pre-Filed Testimony on Behalf of the Chemical Industry Council of Illinois upon:

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Clerk of the Board
Illinois Pollution Control Board
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as indicated above, by e-mail and/or by depositing said document in the United States Mail, postage prepaid, in Chicago, Illinois on July 11, 2005.

/s/ Patricia F. Sharkey
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CHEMICAL INDUSTRY COUNCIL OF ILLINOIS'
SECOND ERRATA SHEET

The Chemical Industry Council of Illinois ("CICI"), by its attorneys Mayer, Brown, Rowe & Maw LLP, hereby submits the following corrections and amendments to documents previously filed in this proceeding:

AMENDMENT TO PROPOSED REGULATORY LANGUAGE

CICI proposes to amend the text of its regulatory language, as proposed in its original filing on April 19, 2005, as follows:

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE B: AIR POLLUTION
CHAPTER I: POLLUTION CONTROL BOARD
PART 201
PERMITS AND GENERAL PROVISIONS

Section
201.146 Exemptions from State Permit Requirements

Construction or operating permits, pursuant to Sections 201.142, 201.143, and 201.144 of this Part, are not required for the classes of equipment and activities listed below in this Section. The permitting exemptions in this Section do not relieve the owner or operator of any source from any obligation to comply with any other applicable requirements, including the obligation to obtain a permit pursuant to Sections 9.1(d) and 39.5 of the Act, Sections 165, 173, and 502 of the Clean Air Act or any other applicable permit or registration requirements.

* * *

hhh) Plastic injection~~, compression, and transfer~~ molding equipment **with an annual through-put not exceeding 5,000 tons of plastic resin** and associated plastic resin ~~handling,~~ **loading, unloading, conveying, mixing,** storage, grinding, ~~granulating,~~ and drying equipment **and associated mold release and mold cleaning agents.**

Respectfully submitted,

CHEMICAL INDUSTRY COUNCIL
OF ILLINOIS

By: /s/ Patricia F. Sharkey
One of Its Attorneys

Dated: July 11, 2005

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Modern Plastics Handbook

Modern Plastics
and
Charles A. Harper Editor in Chief

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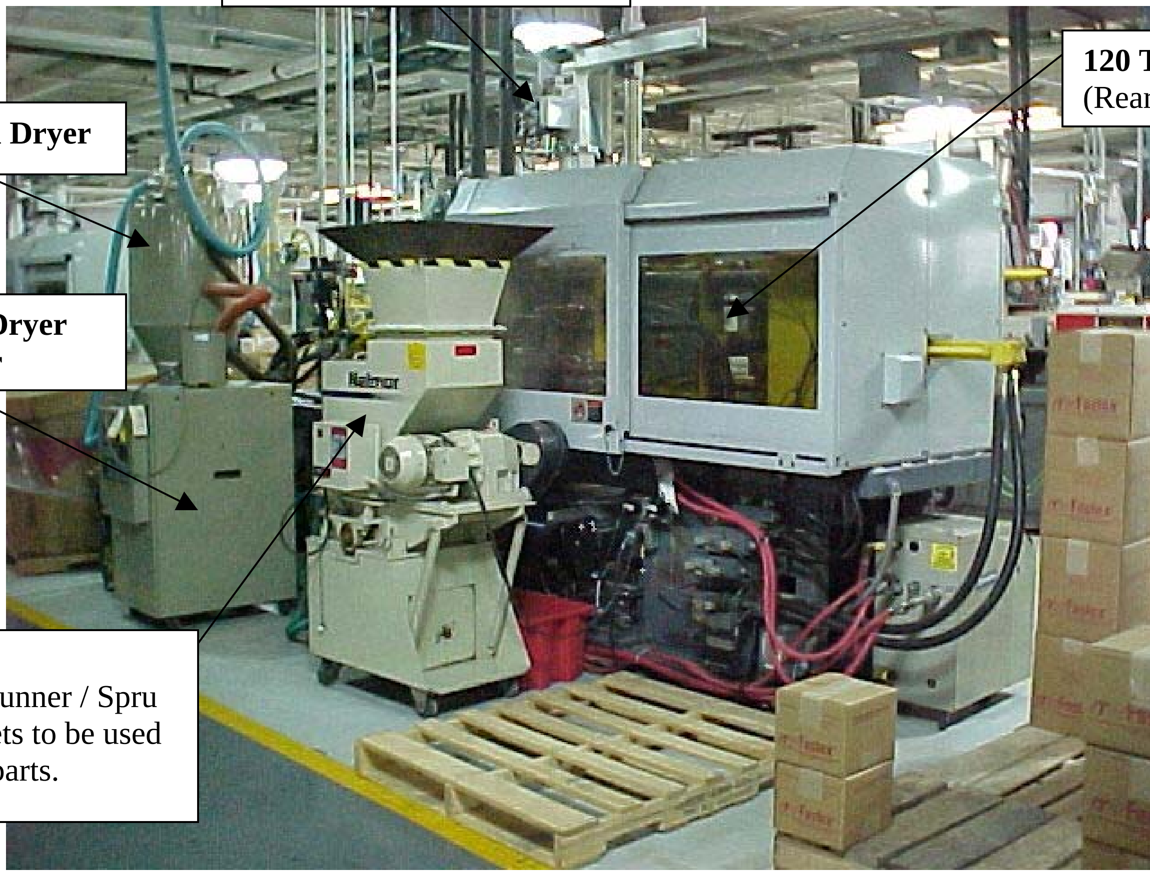
TABLE 5.1 Suggested Drying Conditions for Generic Resins[3,4]

Material	Water absorption, %	Maximum water, %	$T_{extrusion}$, °C	$T_{inj. molding}$, °C	T_{drying}, °C	t_{drying}, h
Acrylonitrile butadiene styrene (ABS)	0.25–0.40	0.20	225	260	88	3–4
Acetal	0.25	—	—	200	93	1–2
Acrylic	0.20–0.30	0.08	190	235	82	1–2
Polyamide-6 (nylon) (PA-6)	1.60	0.15	270	290	82	4–5
Polyamide-6, 6 (nylon) (PA-6,6)	1.50	0.15	265	265	82	4–5
Polycarbonate (PC)	0.20	0.02	290	300	120	3–4
Polybutylene terephthalate (PBT)	0.08	0.04	—	240	125	2–3
Polyethylene terephthalate (PET)	0.10	0.005	250	255	160	4–5
Polyetherimide (PEI)	0.25	—	—	370	155	4–5
High-density polyethylene (HDPE)	<0.01	—	210	250	—	—
Low-density polyethylene (LDPE)	<0.01	—	180	205	—	—
Linear low-density polyethylene (LLDPE)	<0.01	—	260	220	—	—
Polyphenylene oxide (PPO)	0.07	—	250	275	100	2–3
Polypropylene (PP)	<0.01	—	235	255	—	—
Polystyrene (PS)	0.03	—	210	220	—	—
High-impact polystyrene (HIPS)	0.10	—	235	230	—	—
Polyphenylene sulfide (PPS)			—	330	140	2–3
Polysulfone (PSU)	0.30	0.05	345	360	135	3–4
Polyurethane (PU)	0.10	0.03	205	205	82	2–3
PU (elastomers)	0.07	0.03	200	205	100	2–3
r-PVC (polyvinyl chloride)	0.10	0.07	185	195	—	—
p-PVC (polyvinyl chloride)	0.02	—	175	150	—	—
Styrene acrylonitrile (SAN)	0.03	0.02	215	245	82	3–4

While thermoplastic polymers soften at T_g, and if semicrystalline, melt at T_m, cross-linked polymers do not melt and flow (Fig. 5.2*c*[5]). Lightly cross-linked polymers soften as the temperature exceeds T_g, but they remain rubbery solids until the polymer decomposes. Highly cross-linked polymers often do not even soften and retain a high modulus until reaching the decomposition temperature. Thermoset resins, like unsaturated polyester, epoxy, and polyurethanes, have varied levels of cross-linking. However, thermoplastic resins can be modified to contain few cross-links; lightly cross-linked polyethylene (XLPE) often improves the mechanical properties of rotomolded parts.

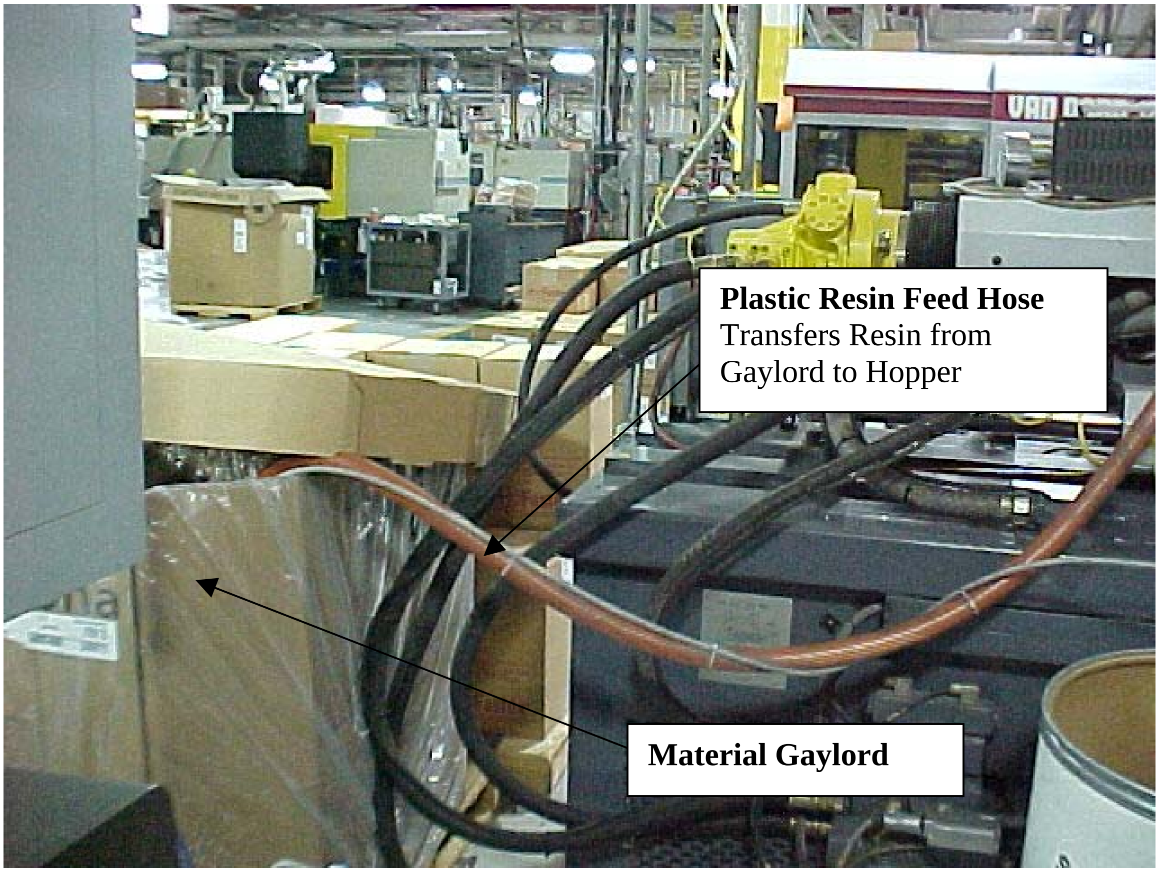
Some thermoplastics will decompose before they melt and flow. Extremely long polymer chains combined with intermolecular attractions prevent conventional melt processing of ultrahigh-molecular-

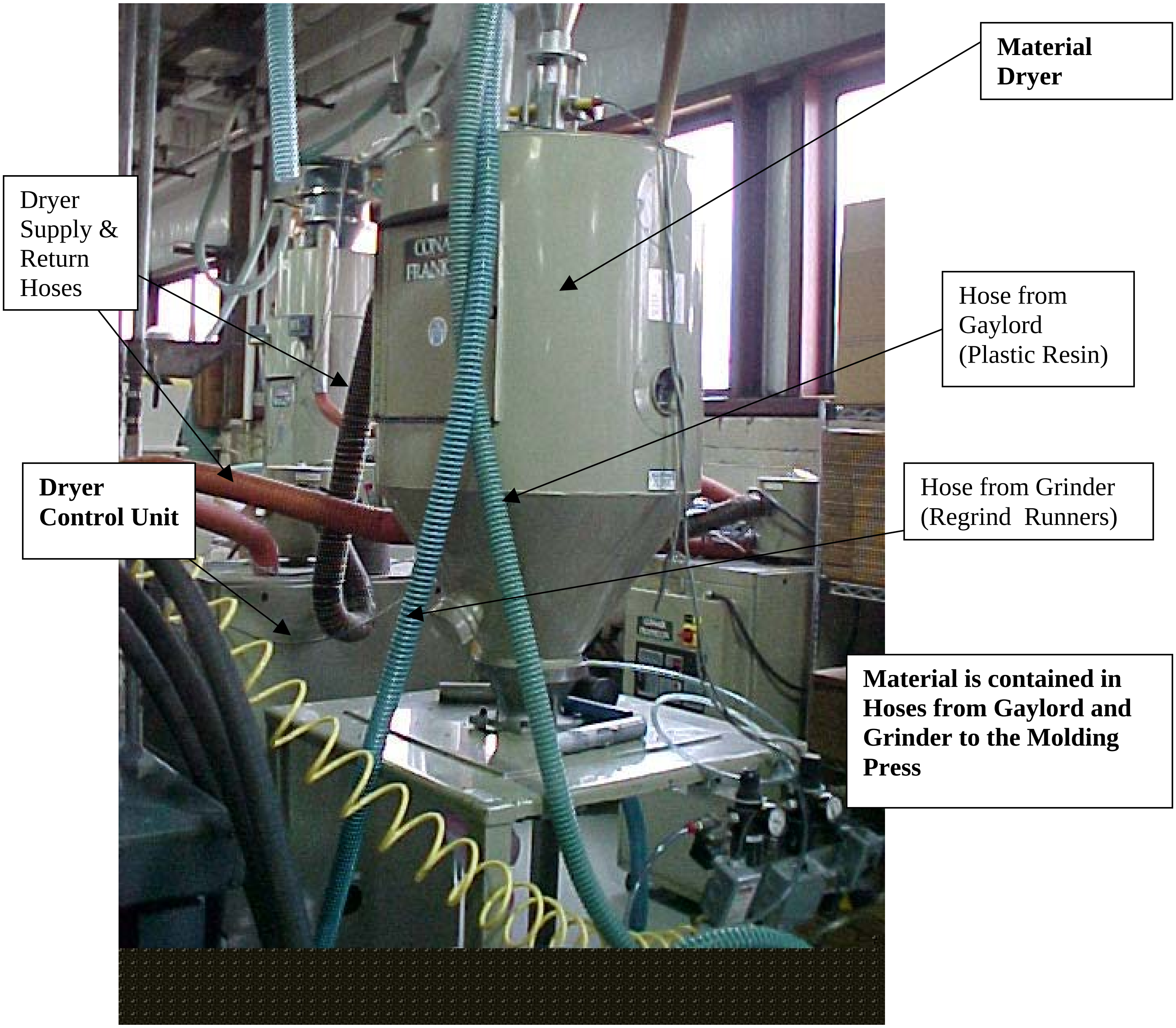

Robot
Transfers Runner / Spru
from Mold to Grinder
120 Ton Press
(Rear View)
Material Dryer
Material Dryer Controller
Grinder
Grinds Runner / Spru
into pellets to be used
to mold parts.

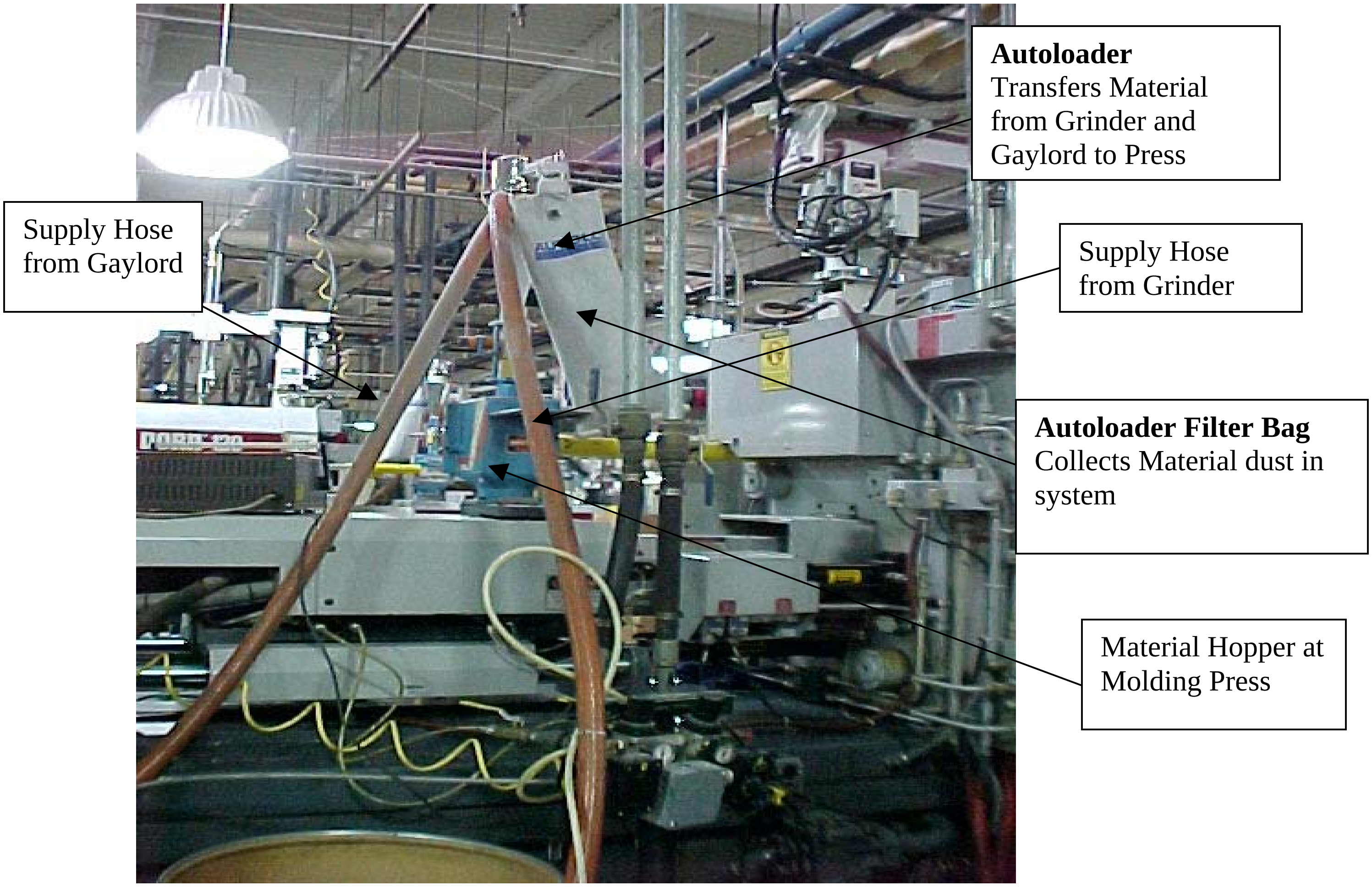
Material mixing shovel

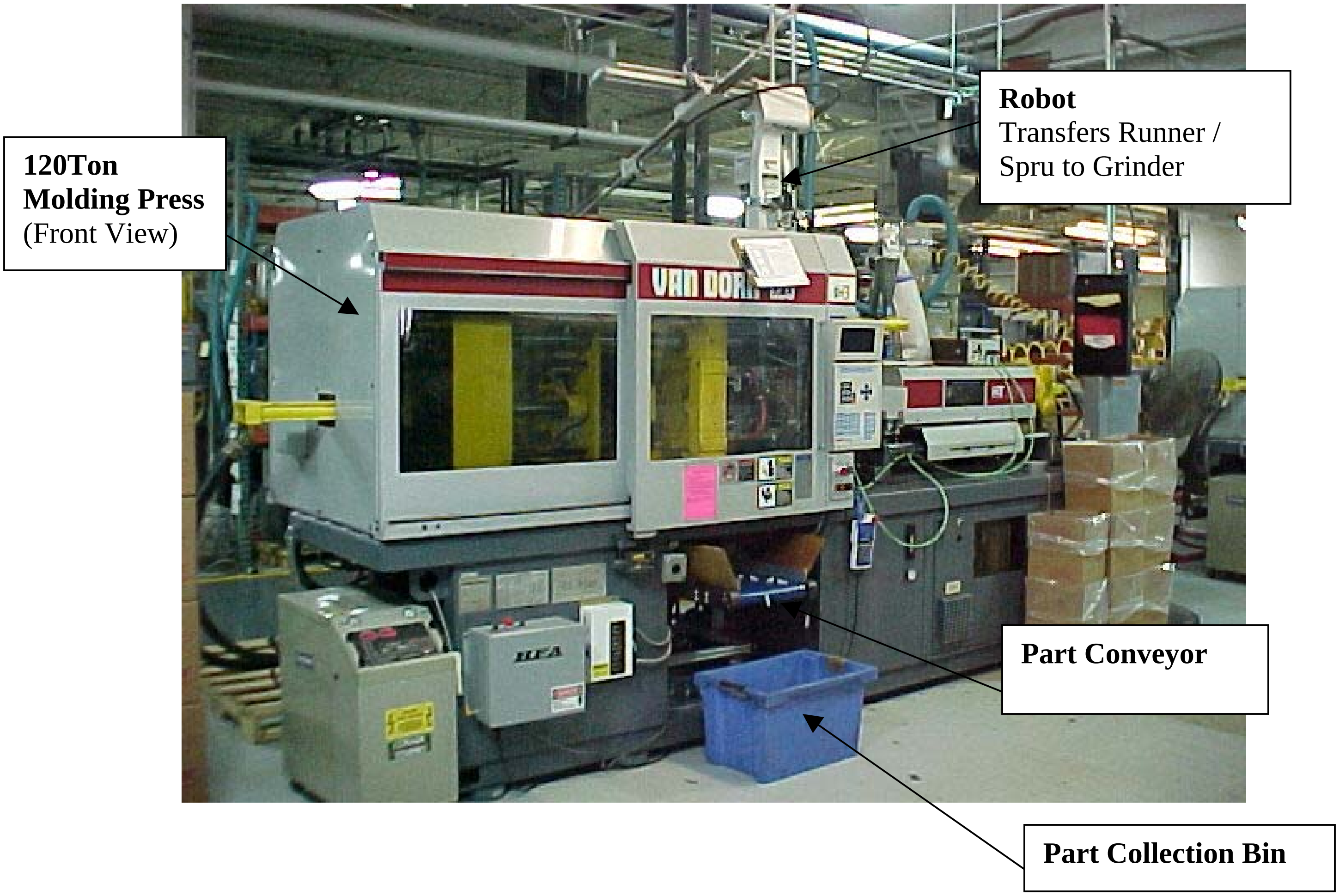
Material Gaylord

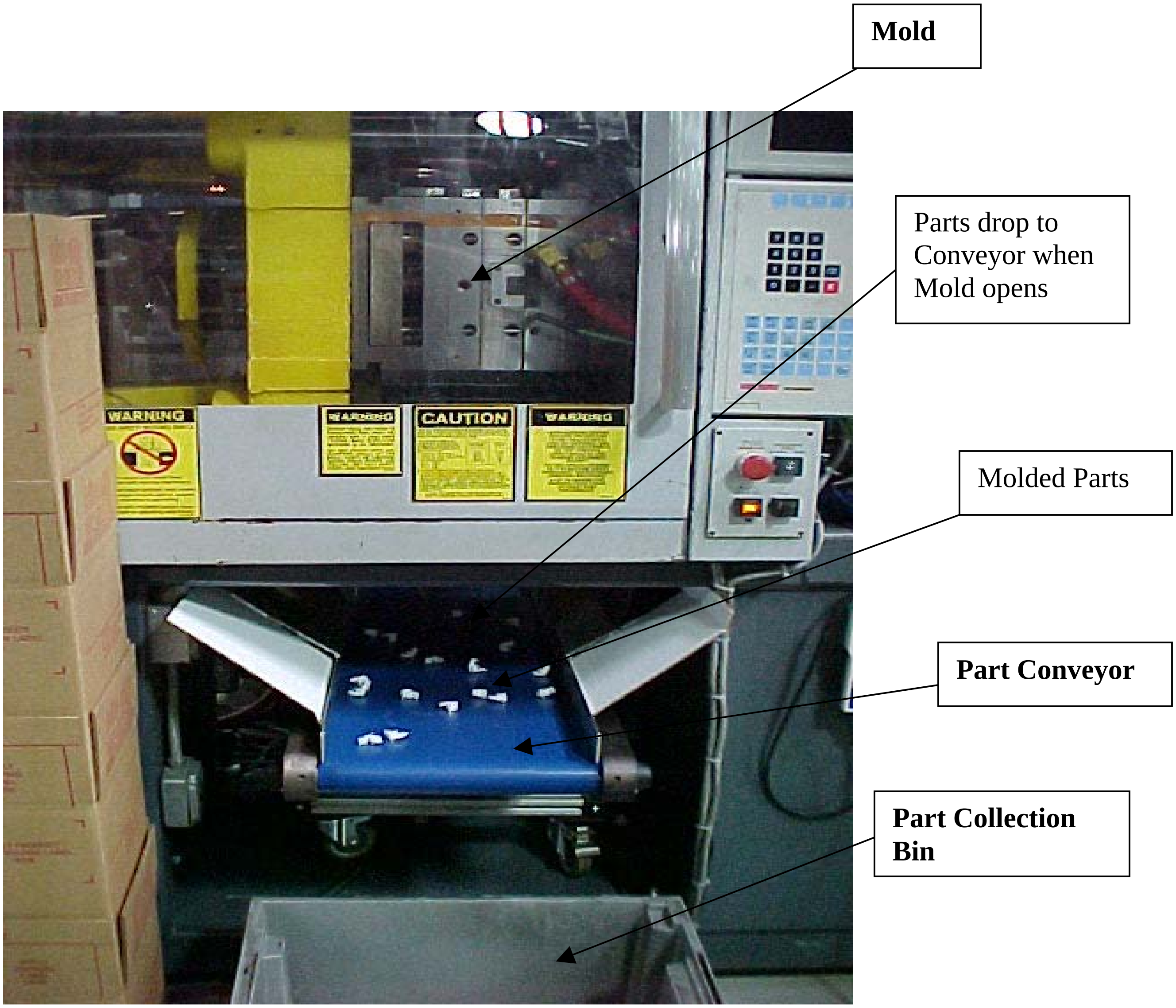
Plastic Resin purchased in Gaylords


Plastic Resin Feed Hose
Transfers Resin from
Gaylord to Hopper
Material Gaylord

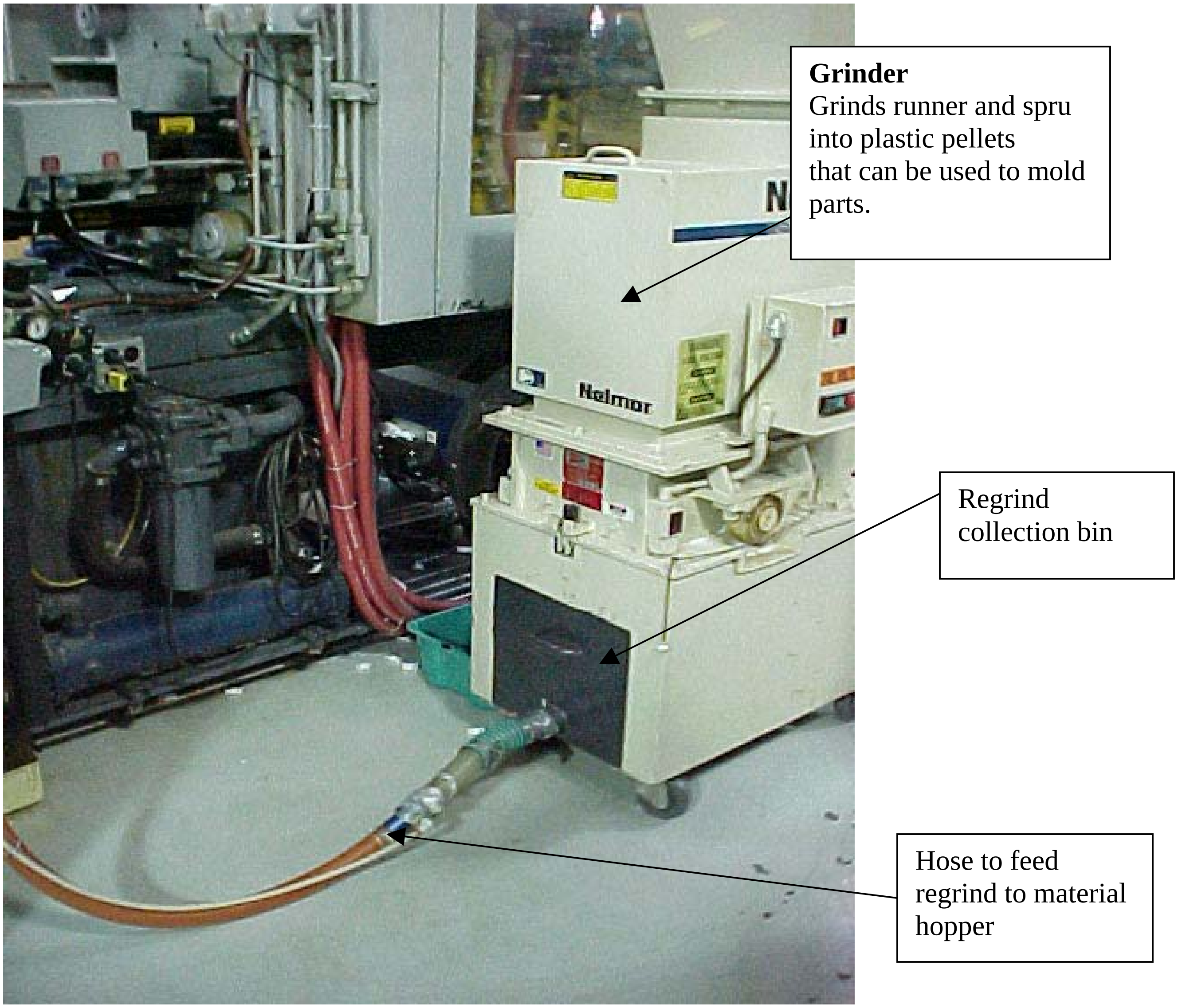

Material Dryer
Dryer Supply & Return Hoses
Hose from Gaylord (Plastic Resin)
Dryer Control Unit
Hose from Grinder (Regrind Runners)
Material is contained in Hoses from Gaylord and Grinder to the Molding Press


Autoloader
Transfers Material from Grinder and Gaylord to Press
Supply Hose from Gaylord
Supply Hose from Grinder
Autoloader Filter Bag
Collects Material dust in system
Material Hopper at Molding Press


120Ton
Molding Press
(Front View)
Robot
Transfers Runner /
Spru to Grinder
Part Conveyor
Part Collection Bin


Mold
Parts drop to Conveyor when Mold opens
Molded Parts
Part Conveyor
Part Collection Bin
WARNING
CAUTION


Robot
Transfers Runner / Spru from Mold to Grinder
Runner / Spru being dropped into Grinder
Grinder
Grinds runner and spru into plastic pellets to be used to mold parts
Nelmor
Nelmor


Grinder
Grinds runner and spru into plastic pellets that can be used to mold parts.
Regrind collection bin
Hose to feed regrind to material hopper