HP 01-2

CenturiCorporation
ESTES INDUSTRIES • COX

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January 23, 2001

Via US Mail

Office of the Secretary
US Consumer Product Safety Commission
Washington, DC 20207

Petition for an Exemption from Banned Hazardous Substances List
(Revised resubmission of November 29, 2000)

Dear Madam/Sir

This is a petition to initiate Commission rulemaking pursuant to 16CFR §1500 2 Authority and is in accordance with 15USC§1261(q)(1) It is a petition to initiate Commission rulemaking to exempt model rocket propellant devices as described in 16 CFR §1500 85(a)(8) so that they may be used to propel model rocket vehicles

An exemption is necessary because the current exemption in 16 CFR § 1500 85(a)(8) for model rocket propellant devices only exempts those designed for use in light-weight, recoverable, and reflyable model rockets Specifically, an exemption is requested to be added to 16 CFR § 1500 85(a) as follows

(14) Model rocket propellant devices (model rocket motors) to propel lightweight surface vehicles such as model rocket cars, provided such devices

- Are designed to be ignited electrically from a minimum distance of 15 feet (4 6 m) away *(This is consistent with the requirements developed and promulgated by the National Association of Rocketry in its Model Rocketry Safety Code for flyable model rockets)*

- Contain no more than 1 1 ounces (30 g) of propellant material and produce no more than 4 48 pound-seconds (20 Newton-seconds) of total impulse with a thrust duration not less than 0 050 seconds *(The 30-gram limit is consistent with U S Department of Transportation classification limits for Model rocket motors, NA 0323 See 49CFR §172 102(c)(1) Code Special Provisions 51)*

- Are constructed such that all the chemical ingredients are preloaded into a cylindrical paper or similarly constructed nonmetallic tube that will not fragment into sharp, hard pieces

- Are designed so that they will not burst under normal conditions of use, are incapable of spontaneous ignition, and do not contain any type of explosive or pyrotechnic material other than a delay and small recovery system activation charge

- Bear labeling and include instructions providing adequate warnings and instructions for safe use

- Comply with the requirements of 16CFR §1500 83 (a)(36)(i-iii)

And for surface vehicles such model rocket cars and kits therefore, provided such devices

- Are lightweight and constructed mainly of materials such as balsa wood or plastics that will not fragment into sharp, hard pieces

- Are designed so that the engine mount is meant to be permanently attached by the manufacturer to a track or track line that will provide control of the vehicle's direction for the duration of its movement

- Are not designed to carry any type of explosive or pyrotechnic material other than the model rocket motor(s) used for primary propulsion

- Are designed to utilize a braking system such as a parachute or shock-absorbing stopping mechanism

- Bear labeling and include instructions providing adequate warnings and instructions for safe use

Following are explanations of the differences between flyable model rockets and model rocket surface vehicles and possible safety implications

- **A flyable model rocket** is designed so that it is aerodynamically stable meaning that it will have a true and predictable flight pattern It is designed to be guided into the air, first by a launching device, which controls its first few feet of flight, and then by fins or other aerodynamic device(s) which work to keep the flying model rocket on its set course
  If it is unstable, its erratic flight takes place in the air, away from people

- **A model rocket vehicle** is designed to travel along the surface of the earth Its course is controlled for the duration of its movement via attachment to a motor mount attached to a track or tethered track line
  Because it is attached to a track or tethered track line, its course cannot become erratic. Instructions and the Rocket Car Safety Code will direct people to maintain a specific distance from the track

- **A flyable model rocket** is constructed with an integral mount for the model rocket propellant device
  The mount is generally centered in the rocket to produce a centered force to carry the rocket upward.

- **A model rocket vehicle** is constructed without the mount The mount for the model rocket propellant device is a permanent and integral part of the track The vehicles, which are interchangeable, must be attached to the mount to run *This assures that the vehicles can only be run on the track The mount is angled to produce a slightly downward thrust to keep the vehicle on the surface and to prevent damage to the track or track line*

- **Both flyable model rockets and model rocket surface vehicles** are propelled with model rocket propellant devices that are to be ignited electrically and remotely
  This protects people from the potential of injury due to ignition and any potential failure of the model rocket propellant device

- The ejection charge of the model rocket propellant device is used to activate the recovery system of a flyable model rocket or a model rocket vehicle
  The recovery system provides for the slow descent of the rocket or activates the braking system of the rocket vehicle. A model rocket vehicle can be also be slowed and stopped by other means such as a drag-parachute or shock-absorbing stopping device attached to the track. These are activated by the forward and controlled course of the vehicle Both flyable model rockets and model rocket vehicles are reusable

Engineering drawings, specifications, bills of materials, product brochures, packaging compositions, instructions and the proposed Estes Rocket Car Safety Code as well as a video and a marketing study have already been provided As recommended in 16CFR §1051 5(c)(5) five copies of the latest revisions of all materials previously provided are enclosed In addition, we have obtained quotations from a testing laboratory for use/abuse testing of the proposed products and will provide five copies of the summary of the results as soon as available

Please advise of additional information that may be required or should you have further questions We will do our best to provide the materials or responses as quickly as possible Thank you for your attention and consideration of our petition

Sincerely,

Barry Tunick,
President
Centuri Corporation

Enclosures 5 Sets

LARGE CAR & TRACK

CONFIDENTIAL

ELECTRIC STARTER

295 H Street Penrose, CO 81240 USA
www.estesrockets.com

ELECTRON BEAM® MODEL ROCKET LAUNCH CONTROLLER INSTRUCTIONS

ELECTRON BEAM® INSTRUCTIONS DU DISPOSITIF DE COMMANDE DE LANCEMENT DE LA FUSÉE MODÈLE RÉDUIT

ANLEITUNG FÜR DAS ELECTRON BEAM STARTKONTROLLGERÄT FÜR MODELLRAKETEN

ote: Your Electron Beam® Launch Controller may look different from the one pictured, but these instructions still apply.
ote: Les instructions reportées restent valables même si l'apparence de votre dispositif de Contrôle de Lancement Electron Beam® est différente de celle de l'illustration.
merkung: Auch wenn Ihr Electron Beam® startkontrollgerat von dem abgebildeten abweicht, gelten diese Anleitungen.

)R YOUR SAFETY

ase note that the Electron Beam® Launch ntroller has a safety key When the safety key is rted into the Electron Beam® Launch Controller, tivates the launch system that ignites the model et's engine To prevent potentially serious injury ourself and others, always follow these simple ty rules.

VEVER connect the Electron Beam® aunch Controller to an igniter, a flight-ready ngine or a rocket until you are outside at ne launch site preparing to launch ~~t the launch site~~ ***never*** insert the safety ey into the Electron Beam® Launch ontroller while you or any others are near ne rocket.
nsert the safety key into the Electron Beam® aunch Controller only when you and all thers are at least 15 feet (5 meters) away om the flight-ready rocket.
n case of misfire, ***never*** approach or allow ny others to approach the rocket until you ve removed the safety key from the lctron Beam® Launch Controller and aited one full minute to be sure the rocket's ngine is not going to ignite.
lemove the safety key from the Electron eam® Launch Controller ***immediately*** fter each and every rocket launch.
way from the launch site, the safety cap ay be placed over the end of the launch d to protect against injury from the launch d.

TE:

small light bulb is used in the controller It tells u when the circuit to your rocket is operational you drop the controller, re-test it as shown in ep 2 If the bulb is broken or does not glow, ease send the controller to Estes We will repair replace it for you.

ie Electron Beam® Launch Controller requires ur AA alkaline batteries (not included) Only kaline batteries are recommended Do not mix d and new batteries or alkaline, standard, and chargeable batteries in the Electron Beam® unch Controller.

POUR VOTRE SÉCURITÉ

Veuillez tenir compte que le dispositif de contrôle de lancement Electron Beam® dispose d'une clé de sécurité Si la clé de sécurité est introduite dans le dispositif de contrôle de lancement Electron Beam®, le système de lancement sera activé et allumera le moteur de la fusée modèle réduit Afin d'éviter tout dommage corporel sérieux qui peuvent être occasionné à vous-même et à d'autres personnes, suivez toujours les règles de sécurité suivantes

A. **NE JAMAIS** raccordez le dispositif de commande de lancement Electron Beam® à un allumeur, à un moteur en ordre de vol ou à une fusée avant d'avoir quitter la zone où le lancement est en cours
B. Dans la zone de lancement n'insérez **jamais** la clé de sécurité dans le dispositif de contrôle de lancement Electron Beam® si vous ou d'autres personnes se trouvent à proximité de la fusée
C. Introduisez la clé de sécurité dans le dispositif de contrôle Electron Beam® uniquement lorsque vous et toute autre personne se trouvent à au moins cinq mètres de la fusée sur le point de décoller.
D. En cas de problème d'allumage, ne vous approchez **jamais** ou n'autorisez jamais qui que ce soit de s'approcher de la fusée avant d'avoir enlevé la sécurité du dispositif de contrôle de lancement Electron Beam® et attendez au moins une minute pour être certain que le moteur de la fusée n'est pas sur le point de s'allumer
E. Ôtez **immédiatement** la clé de sécurité du dispositif de contrôle de lancement Electron Beam® après chaque lancement de la fusée.
F. A distance de la zone de lancement, il est possible de placer le capuchon de sécurité sur l'extrémité de la tige de lancement de manière à éviter qu'elle ne puisse provoquer des dommages

NOTE:

1. Une petite ampoule est utilisée dans le dispositif de contrôle Cela indique que le circuit de votre fusée est opérationnel Si vous faites tomber le dispositif de contrôle, verifiez le fonctionnement comme indiqué à l'étape 2 Si l'ampoule est brisée ou ne s'allume pas, retournez le dispositif de contrôle à Estes Il vous sera réparé ou remplacé
2. Le dispositif de contrôle Electron Beam® à besoin de 4 piles alkalines AA (non comprises) pour fonctionner Nous recommandons d'utiliser uniquement des piles alkalines Ne mélangez pas des piles neuves avec des piles anciennes, et des piles alkalines avec des piles ordinaires ou des piles rechargeables dans le dispositif de contrôle Electron Beam®

ZU IHRER SICHERHEIT

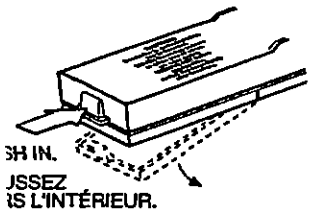
Bitte beachten Sie, daß das Electron Beam® Startkontrollgerät mit einem Sicherheitsschlüssel ausgestattet ist. Wird dieser in das Electron Beam® Startkontrollgerät eingesteckt, aktiviert er das Startsystem, das den Motor der Modellrakete zündet Um sich selbst oder andere vor potentiellen schweren Verletzungen zu schützen, beachten Sie stets diese einfachen Sicherheitsregeln.

A. Schließen Sie das Electron Beam® Startkontrollgerät **NIE** an einen Zünder, einen flugbereiten Motor oder eine Rakete an, bevor Sie sich nicht im Freien am Startplatz bei den Startvorbereitungen befinden.
B. Stecken Sie am Startplatz NIEMALS den Sicherheitsschlüssel in das Electron Beam® Startkontrollgerät, solange Sie oder andere sich in der Nahe der Rakete befinden.
C. Stecken Sie den Sicherheitsschlüssel in das Electron Beam® Start-kontrollgerat erst dann ein, wenn Sie und alle anderen mindestens 5 Meter weit von der flugbereiten Rakete entfernt sind.
D. Im Falle einer Fehlzundung nähern Sie sich NIE der Rakete und erlauben Sie es auch anderen nicht, ehe Sie den Sicherheitsschlüssel aus dem Electron Beam® Startkontrollgerät entfernt haben und warten Sie mindestens eine volle Minute, um sicher zu sein, daß der Motor der Rakete nicht zündet
E. Entfernen Sie den Sicherheitsschlüssel des Electron Beam® Start- kontrollgerats **SOFORT** nach jedem Raketenstart
F. Wenn Sie sich vom Startplatz entfernen, kann die Sicherheitskappe zum Schutz vor Verletzungen auf das Ende des Leitstabs gesetzt werden

ANMERKUNG:

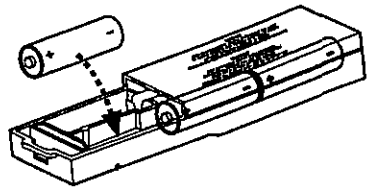
1. Eine kleine elektrische Birne im Kontrollgerät gibt an, wenn der Stromkreis Ihrer Rakete einsatzfähig ist Sollte das Kontrollgerät herunterfallen, muß es nochmal getestet werden wie im Arbeitsgang 2 angegeben Wenn die Birne kaputt ist oder nicht aufglüht, schicken Sie bitte das Kontrollgerät an Estes Wir werden es entweder reparieren oder ersetzen
2. Das Electron Beam® Startkontrollgerät benotigt 4 AA Alkalibatterien (nicht enthalten) Nur Alkalibatterien werden empfohlen Mischen Sie keine alten und neuen Batterien oder Alkali-, Standard- und wiederaufladbare Batterien im Electron Beam® Startkontrollgerat

Install Batteries
Installation des piles
Installieren der Batterien



3H IN.
JSSEZ
IS L'INTÉRIEUR.
CH INNEN DRÜCKEN

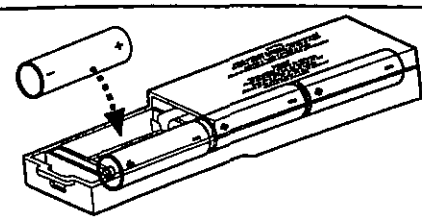
A. Open compartment.
Ouvrez le compartiment.
Das Fach öffnen.



B. Insert three AA batteries in one side ~~BE SURE TO~~ NOTE POLARITY

Introduisez les trois piles AA d'un côté EN VEILLANT À RESPECTER LA POLARITÉ INDIQUÉE.

Setzen Sie drei AA-Batterien in eine Seite ein ACHTEN SIE AUF DIE POLARITÄT



C. Insert one battery in other side ~~BE SURE TO~~ NOTE POLARITY
Introduisez une pile de l'autre côté en VEILLANT À RESPECTER LA POLARITÉ INDIQUÉE.
Setzen Sie eine Batterie in die andere Seite ein ACHTEN SIE AUF DIE POLARITÄT

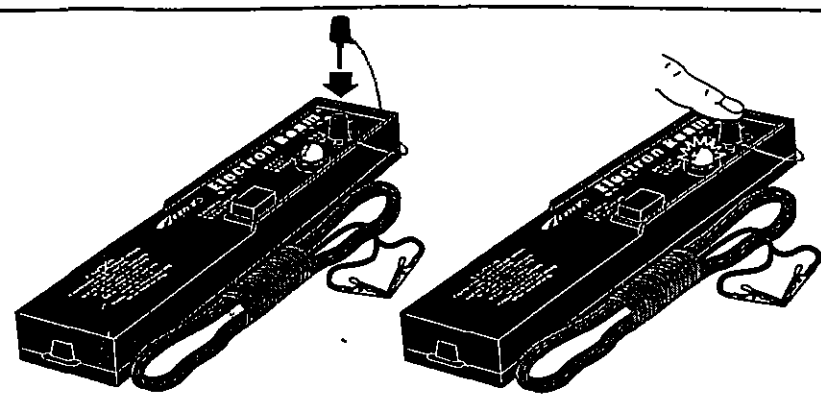
D. Replace the battery compartment door
Remettez la porte du compartiment de piles en place
Setzen Sie die Abdeckung des Fachs wieder ein

Test Controller
Test du dispositif de contrôle
Testen des Kontrollgeräts

Clip micro-clips together. (Continuity light will not glow without safety key in place If it does, do not use the controller Return the controller to Estes for a replacement)

Fixez les micro-clips l'un à l'autre (La lampe de continuité ne s'allumera pas tant que la clé de sécurité n'est pas mise en place Dans le cas contraire, n'utilisez pas le dispositif de contrôle et retournez-le à Estes pour le remplacer).

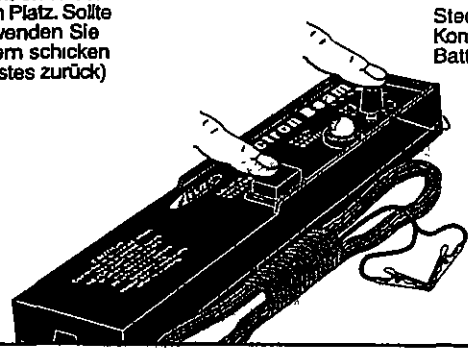
Stecken Sie die Mikroklemmen zusammen Das Kontrollicht leuchtet nicht ohne den Sicherheitsschlüssel an seinem Platz. Sollte es dennoch aufleuchten, verwenden Sie das Kontrollgerät nicht, sondern schicken Sie es zum Austauschen an Estes zurück)



B. Insert safety key. Press in and **hold** safety key down Continuity light should glow with a bright white light (A dim yellow light indicates weak batteries)

Introduisez la clé de sécurité Appuyez et tenez avec votre doigt la clé de sécurité La lampe de continuité devrait s'illuminer de couleur blanc vif (Une illumination de couleur jaune claire indique que les piles sont déchargées)

Stecken Sie den Sicherheitsschlüssel ein und drücken Sie ründer Das Kontrollicht sollte hell weiß aufleuchten (Ein mattes Gelb weist auf schwache Batterien hin).



C. While holding the safety key down, press and hold down the launch button The continuity light will go out while both buttons are depressed.

Pressez et tenez le bouton de lancement enfoncé La lampe de continuité s'éteindra lors du relâchement du bouton

Während Sie den Sicherheitsschlüssel eindrücken, drücken Sie ebenfalls den Startknopf und halten Sie ihn in dieser Position Das Kontrollicht erlischt, wenn beide Knopfe heruntergedrückt werden

ntroller does not behave as described ve, check the following:

~~Be sure the~~ micro-clips are firmly clipped ether.

nove the safety key, reinsert it and press it down member that if your Electron Beam® Launch ntroller is connected to a rocket, the safety key uld only be inserted when no one is near the ket).

~~Be sure~~ batteries are charged and properly lled

e launch controller still does not function rectly, please see the enclosed warranty

ure to follow "Countdown and Launch" uctions included with your rocket.

Si le dispositif de contrôle ne se comporte pas de la manière reportée ci-dessus, contrôlez les points suivants:

- Vérifiez que les micro-clips sont bien fixés l'un à l'autre
- Ôtez la clé de sécunté, et réintroduisez-la en pressant avec votre doigt (N'oubliez pas que si le dispositif de contrôle du lancement Electron Beam® est raccordé à la fusée, la clé de sécurité ne peut être insérée que si personne ne se trouve à proximite de la fusée)
- Vérifiez que les piles sont chargées et correctement installées
- Si le dispositif de contrôle de lancement ne fonctionne toujours pas correctement, prenez connaissance de la garantie ci-jointe

Veiller à suivre les instructions relatives au "Compte à rebours et au lancement" accompagnant votre fusée.

Verhält sich das Startkontrollgerat nicht wie oben beschrieben, überprüfen Sie Folgendes:

- Achten Sie darauf, daß die Mikroklemmen fest zusammengesteckt sind
- Ziehen Sie den Sicherheitsschlüssel raus und stecken Sie ihn dann wieder ein und drücken Sie ihn nach unten (Denken Sie daran Wenn ihr Electron Beam® Startkontrollgerät an eine Rakete angeschlossen ist, darf Sicherheitsschlüssel erst dann eingesteckt werden, wenn niemand in der Nähe der Rakete ist)
- Achten Sie darauf, daß die Batterien aufgeladen und richtig eingesetzt sind
- Funktioniert das Startkontrollgerät immer noch nicht richtig, sehen Sie bitte in der beigelegten Garantie nach

Halten Sie sich unbedingt an die der Rakete beiliegenden "Countdown und Start"-Anweisungen

(12/99) 83514

PROPELLANT

DEVICES

U.S. Department
of Transportation

**Research and
Special Programs
Administration**

400 Seventh Street S W
Washington D C 20590

**The US Department of Transportation
Competent Authority for the United States**

CLASSIFICATION OF EXPLOSIVES

Based upon a request by Mary Roberts on behalf of Centuri Engineering Company d/b/a Estes Ind., P.O. Box 227, 1295 H Street, Penrose, Colorado, the following items are classed in accordance with Section 173.56, Title 49, Code of Federal Regulations (49 CFR).

U.N. PROPER SHIPPING NAME AND NUMBER:

Articles, pyrotechnic, UN0432 (see note 1)

U.N. CLASSIFICATION CODE: 1.4S

REFERENCE NUMBER	PRODUCT DESIGNATION/PART NUMBER
EX-8007022	D12-0
EX-8007023	D12-3
EX-8007024	D12-5
EX-8007025	D12-7
EX-9001146	1/2A3-2T
EX-9001147	1/2A3-4T
EX-9001148	A3-4T
EX-9001149	A10-0T
EX-9001150	A10-3T
EX-9001151	1/2A6-2
EX-9001152	A8-3
EX-9001153	A8-5
EX-9001154	B4-2
EX-9001155	B4-4
EX-9001156	B4-6
EX-9001157	B6-0
EX-9001158	B6-2

Roberts, Centuri Engineering Company d/b/a Estes Ind.

Articles, pyrotechnic, UN0432 (continued)

REFERENCE NUMBER	PRODUCT DESIGNATION/PART NUMBER
EX-9001159	B6-4
EX-9001160	B6-6
EX-9001161	B8-5
EX-9001162	C5-3
EX-9001163	C6-0
EX-9001164	C6-3
EX-9001165	C6-5
EX-9001166	C6-7

Note 1 - For domestic shipments these items may be classed as Model rocket motor, NA 0323, 1.4S.

***** The following is provided to facilitate transition to the UN system *****

Classification under Sections 173.86 or 173.114a (49 CFR):

DOT DESCRIPTION/COMMERCIAL NAME: Toy propellant device

DOT HAZARD CLASSIFICATION: Class C explosive

Approved by:

Alan I. Roberts
Associate Administrator
for Hazardous Materials Safety

JUN - 8 1995

(DATE)

US Department
of Transportation

**Research and
Special Programs
Administration**

400 Seventh Street S W
Washington D C 20590

**The US Department of Transportation
Competent Authority for the United States**

CLASSIFICATION OF EXPLOSIVES

Based upon a request by Mary Roberts on behalf of Estes Industries/Hi-Flier Manufacturing Co., P.O. Box 227, 1295 H Street, Penrose, Colorado, the following items are classed in accordance with Section 173.56, Title 49, Code of Federal Regulations (49 CFR).

U.N. PROPER SHIPPING NAME AND NUMBER:

Articles, pyrotechnic, UN0432 (see note 1)

U.N. CLASSIFICATION CODE: 1.4S

REFERENCE NUMBER	PRODUCT DESIGNATION/PART NUMBER
EX-9203159	D11-P Model Rocket Engine

Note 1 - For domestic shipments these items may be classed as Model rocket motor, NA 0323, 1.4S.

***** The following is provided to facilitate transition to the UN system *****

Classification under Sections 173.86 or 173.114a (49 CFR):

DOT DESCRIPTION/COMMERCIAL NAME: Toy propellant device

DOT HAZARD CLASSIFICATION: Class C explosive

U.N. PROPER SHIPPING NAME AND NUMBER: Rocket motors, UN0186 (see note 2)

U.N. CLASSIFICATION CODE: 1.3C

REFERENCE NUMBER	PRODUCT DESIGNATION/PART NUMBER
EX-9303092	E15-4
EX-9303093	E15-6
EX-9303094	E15-8
EX-9303095	E15-P

Note 2 - For domestic shipments these items may be classed as Model rocket motor, NA 0276, 1 4C.

Roberts, Estes Industries/Hi-Flier Manufacturing Co.

Rocket motors, UN0186 (continued)

***** The following is provided to facilitate transition to the UN system *****

Classification under Sections 173.86 or 173.114a (49 CFR):

DOT DESCRIPTION/COMMERCIAL NAME: Rocket motor

DOT HAZARD CLASSIFICATION: Class B explosive

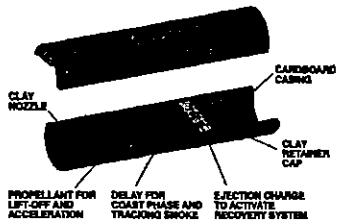
Approved by:

Alan I. Roberts
Associate Administrator
for Hazardous Materials Safety

JUN - 8 1995
(DATE)

These are the famous model rocket engines that made model rocketry the safe hobby it is today They incorporate a safe, intelligent design, manufactured under precise and strict engineering tolerances Estes model rocket engines have been proven consistent and reliable in more than 300,000,000 launches They are the key to the outstanding safety record model rocketry has achieved over the past 40 years

- The concept of a factory assembled model rocket engine is the foundation of this safe, scientific and educational activity!
- 3% of all Estes engines are static-tested at the factory for reliability and adherence to performance specs
- All engines comply with the codes of the National Fire Protection Association and are certified by the National Association of Rocketry

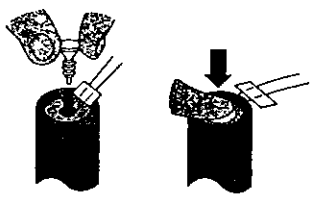


HOW DOES A MODEL ROCKET ENGINE WORK?

1 Insert engine into rocket Insert igniter and igniter plug into engine Place rocket over launch rod on launch pad, hook igniter clips to igniter
U S Patent Nr 5,509,354

2 When launch button is pushed, engine produces thrust and boosts rocket into the sky

MAKE CERTAIN SAFETY KEY HAS BEEN REMOVED FROM CONTROLLER!



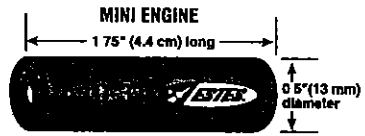
3 After propellant is used up, delay is activated, allowing rocket to coast.

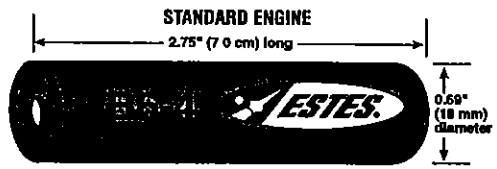
4 After delay, ejection charge is activated, deploying recovery system

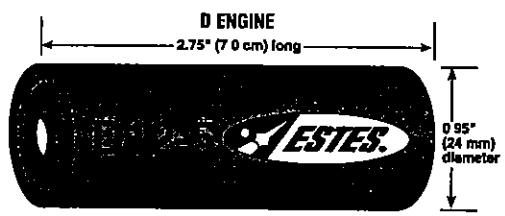
WHAT SIZES ARE AVAILABLE?

Estes engines are available in a wide variety of sizes and power levels

TYPE	TOTAL IMPULSE	ENGINE TYPES
1/2A	0 626 - 1 25	Standard, Mini
A	1 26 - 2 50	Standard, Mini
B	2 51 - 5 00	Standard
C	5 01 - 10 00	Standard
D	10 01- 20 00	"D" Size



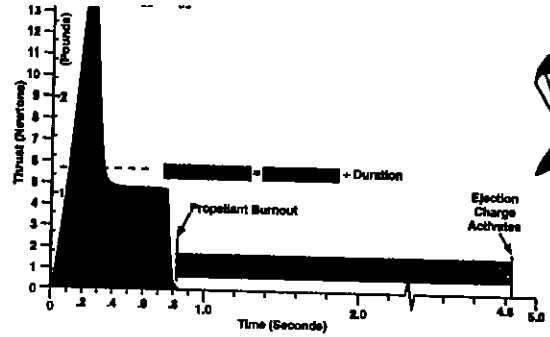


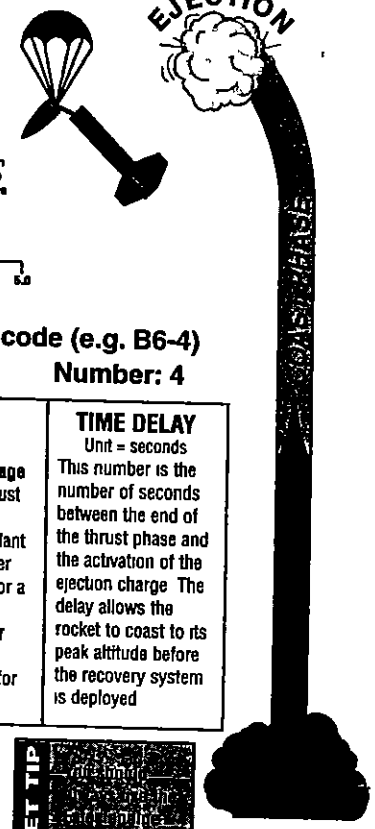


WHAT DO THE DIFFERENT COLOR ENGINES MEAN?

Each type of engine is printed in a different color

Single Stage engines are printed green
Upper Stage engines are printed purple (Upper stage engines can be used as single stage engines in lightweight rockets)
Booster engines are printed red (Booster engines contain no delay or ejection charge)
Plugged engines are printed black. (They are used for R/C gliders and contain no





Each engine has a letter-number-number code (e.g. B6-4)

Letter: B **Number: 6** **Number: 4**

TOTAL IMPULSE

Unit = Newton seconds (N-sec)

This letter indicates the total power the engine produces **Total Impulse** is measured in Newton-seconds One Newton-second is the total impulse produced by one Newton of thrust for a duration of one second A "B" engine (5 N-sec) can produce up to 5 newtons of thrust for 1 sec, 10 newtons for 1/2 sec or any combination that equals up to 5 N-sec (1N = 0 225 lbs)

AVERAGE THRUST

Unit = Newton

This number tells you the **Average Thrust** of the engine during thrust phase The actual thrust varies during engine burn The propellant may burn quickly giving a higher average thrust or burn slowly for a lower average thrust Generally, higher average thrust is best for heavier rockets, lower average thrust is usually more efficient for smaller, lighter rockets

TIME DELAY

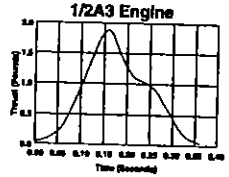
Unit = seconds

This number is the number of seconds between the end of the thrust phase and the activation of the ejection charge The delay allows the rocket to coast to its peak altitude before the recovery system is deployed

TIME/THRUST CURVES

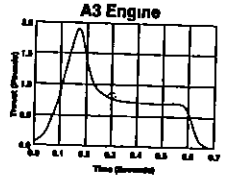
- Time/thrust curves are representative of random production samples
- Time/thrust curve graphs are shown in pounds (not Newtons)
- Graphs are not drawn to the same scale

1/2A3 Engine

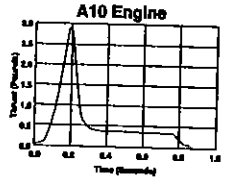


ROCKET TIP

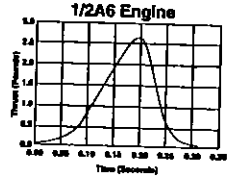
A3 Engine



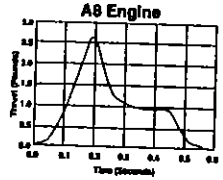
A10 Engine



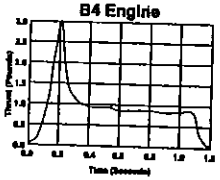
1/2A6 Engine



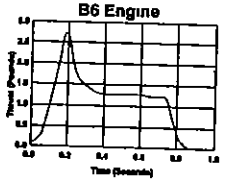
A8 Engine



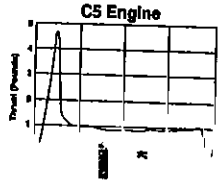
B4 Engine



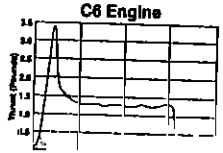
B6 Engine



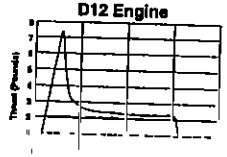
C5 Engine



C6 Engine



D12 Engine



ENGINE CHART

- Delays have a tolerance of plus or minus 10% or 1 second, whichever is greater
- All Estes engines come complete with igniters and patented Igniter Plugs (Pat No 5,509,354) The Estes Igniter Plug makes engine ignition extremely reliable.
- Do not fly a rocket/engine combination whose maximum lift-off weight exceeds the recommended maximum lift-off weigi

Prod. No.	Engine Type	Total Impulse	Time Delay	Max. Lift Weight		Max. Thrust		Thrust Duration	Initial Weight		Propellant Weight	
		N-sec	Sec	oz	gm	Newtons	Lbs	Sec	oz	gm	oz	gm
1503	1/2A3-2T	1 25	2	2 0	57	8 3	1 9	0 3	0 20	5 6	0 06	1 75
1593	1/2A6-2	1 25	2	2 0	57	11 8	2 7	0 3	0 53	15 0	0 06	1 56
1507	A3-4T	2 50	4	2 0	57	8 5	1 9	0 6	0 27	7 6	0 12	3 50
1511	A10-3T	2 50	3	3 0	85	13 0	2 9	0 8	0 28	7 9	0 13	3 78
1598	A8-3	2 50	3	3.0	85	11 8	2 7	0 5	0.57	16 2	0 11	3 12
1601	B4-2	5 00	2	4 0	113	13 2	3 0	1 1	0 70	19 8	0 29	8 33
1602	B4-4	5 00	4	3 5	99	13 2	3 0	1 1	0 74	21 0	0 29	8 33
1605	B6-2	5.00	2	4 5	127	12 1	2 7	0 8	0 68	19 3	0 22	6 24
1606	B6-4	5 00	4	4.0	113	12 1	2 7	0 8	0 71	20 1	0 22	6 24
1617	C5-3	10 00	3	8 0	226	21.0	4.7	1 9	0 90	25 5	0 45	12 70
1613	C6-3	10 00	3	4 0	113	15 3	3 4	1.6	0 88	24 9	0 44	12 48
1614	C6-5	10 00	5	4 0	113	15 3	3 4	1 6	0 91	25 8	0 44	12 48
1666	D12-3	20.00	3	14 0	396	32 9	7 4	1 6	1 49	42 2	0 88	24 93
1667	D12-5	20 00	5	10 0	283	32.9	7 4	1 6	1 52	43 1	0 88	24 93
1504	1/2A3-4T	1 25	4	1 0	28	8 3	1 9	0 3	0 21	6 0	0 06	1 75
1607	B6-6	5 00	6	2 5	71	12 1	2 7	0 8	0 78	22 1	0 22	6 24
1615	C6-7	10 00	7	2 5	71	15 3	3 4	1 6	0.95	26 9	0 44	12 48
1668	D12-7	20 00	7	8 0	226	32 9	7 4	1 6	1 55	44 0	0 88	24 93
1510	A10-0T	2 50	None	5 0	142	13 0	2 9	0 8	0.24	6 7	0 13	3 70
1608	B6-0	5 00	None	4 0	113	12 1	2 7	0 8	0 58	16 4	0 22	6 24
1616	C6-0	10 00	None	4 0	113	15.3	3 4	1 6	0 80	22 7	0 44	12 48
1665	D12-0	20 00	None	14 0	396	32.9	7 4	1 6	1 44	40 9	0 88	24 93
PLUGGED ENGINES - FOR USE WITH R/C ROCKET GLIDER (BLACK LABEL												
1669	D11-P	20 00	None	16 0	453	27 6	6 2	1 8	1 55	44 0	0 88	24 93

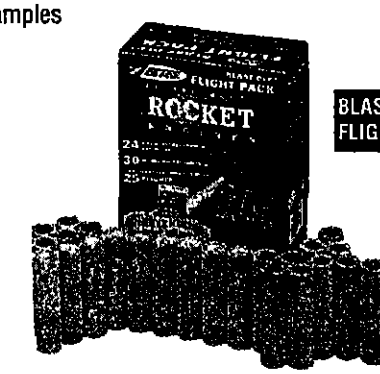
The data listed above is from randomly chosen production samples
NOTE The "T" designates a mini-engine

FLIGHT ACCESSORIES

BLAST-OFF® FLIGHT PACK

EST 1672

Contains 24 engines, 24 igniter plugs , 30 igniters and a pack of recovery wadding Engines include six each of the A8-3, B6-4, C6-3 and C6-5 Ideal way to have fun on a Saturday afternoon!



RECOVERY WADDING

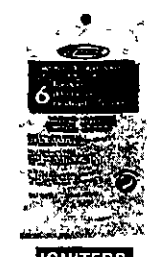
EST 302274

Flame resistant wadding to protect your recovery system Required in most Estes rockets Contains 75 sheets – enough for about 18-25 flights!

IGNITERS

EST 302301

Dependable, easy-to-use Estes igniters in a convenient



D11-P PLUGGED

Estes Industries, Penrose, CO

MODEL ROCKET MOTOR
NA 0323, 1.4S, Plugged
MOTEUR-FUSEE MINIATURE
Article, Pyrotechnic
UN 0432, 1.4S, Moteur Bouché

WARNING - FLAMMABLE
Read Instructions Before Use
DO NOT BURN SOAK IN WATER TO DESTROY

AVERTISSEMENT - INFLAMMABLE
Lirez instructions avant usage
NE PAS INCINÉRER. DETRUIRE TREMPE DANS L'EAU

MADE IN USA
FABRIQUE A EU

Certified
MR-0057

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MR-0057

ESTES INDUSTRIES
1295 H Street
Penrose, CO 81240 USA
www.estesrockets.com

MODEL ROCKET ENGINE AND IGNITER INSTRUCTIONS

MR-0057

WARNING - FLAMMABLE

A model rocket engine works by burning its contents are flammable. To avoid being badly burned never damage, unwrap an engine or take it apart No one *should be near an engine when it is ignited. Use only* igniters to ignite an engine

USERS & PARENTS - IMPORTANT

Read the instructions for your safety Follow the warnings Do not use the engines or igniters until you do. If you have questions, write to Customer Service at the address above

NOTE Laws and rules where you live may differ from our instructions or recommendations If so, you must obey your state and local laws and rules

SAFETY Read the Model Rocket Safety Code Always follow the rules.

1 ***ATTENTION*** *Engines and igniters need* to be used with care An adult should help any child less than 12 years old In Canada only, persons under the age of 12 may not possess engines Anyone who cannot read or follow instructions should have help too.

2. FIRST AID For burns apply first aid Call a doctor if the burn is serious If swallowed, cause vomiting and call a doctor

3. IN CASE OF FIRE. If there is a fire near model rocket engines, get away Do not try to put the fire out Ignited model rocket engines may fly and hurt someone.

4 STORAGE Keep engines away from fire or *sparks so they won't ignite by accident. Don't freeze* or put them in a place that gets warmer than 140 F (60 C) This or moisture can damage them

5 DISPOSAL. Do not use damaged model rocket engines Soak them in water for a day or two until they come apart. Then put the remnants in the trash outside

PRELAUNCH CHECK For safety, never launch a damaged rocket Check the rocket. Check the engine mount and launch lugs too. Fix any damage before launch

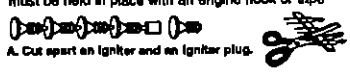
RECOVERY SYSTEM Follow the instructions for the rocket. Fix any damage See if recovery wadding *is needed. Use the right amount* Wadding is treated to resist fire It helps to protect the recovery system and to prevent fires

USE THE RIGHT ENGINE Read and follow the instructions that came with your rocket. Only use the engines listed Follow the steps to install your engine and to launch your rocket.

INSTALLING ENGINE(S) AND IGNITER

Put an igniter in an engine only when you are outside Don't insert it until ready to launch Remove igniter if you don t launch

If your rocket has an engine lock ring put the engine and lock ring in the rocket Then install the igniter If not, you may put the igniter in the engine before or after putting the engine in the rocket. The engine must be held in place with an engine hook or tape



A. Cut apart an igniter and an igniter plug.

B Check the igniter It won't work if the wires touch. Gently pull them apart if needed.

C. Put the igniter all the way into the engine Do not bend.

D. Push plug all the way in.

E. Bend the wires into a U-shape

Igniter must touch propellant.

Engine	Plug Color
A3	Orange
A10	Green
A8/B4	Yellow
B6/C6	Pink
D12	White

SETTING UP FOR LAUNCH For safety, make certain the key is not in the controller (If it is, the engine may ignite and injure you)

Remove the safety cap from the launch rod. Lower rocket launch lug(s) over launch rod Rocket must slide easily up and down rod

A standoff is needed to hold the rocket up off the blast deflector If needed make a standoff by wrapping some masking tape around the launch rod.

Clip clean micro-clips to each lead of the igniter Clips must not touch each other, the rod or the blast deflector

COUNTDOWN Everyone must move away from the rocket. Check that there is no aircraft or other object overhead Insert the key in the controller You may need to hold it in place The controller light should glow Count down aloud 5 4 3 2 1, press and hold the launch button until the engine ignites

LIFTOFF!

When rocket lifts off, remove key Replace safety cap on launch rod Retrieve the rocket.

MISFIRES Take the key out of the controller Wait one minute before going near the rocket!

Take the plug and igniter out of the engine A burned igniter means it was not touching the propellant. Put *a new igniter all the way into the engine Don't bend* it Push the plug in place Repeat the steps under Countdown

If the igniter has not burned put it back in the engine Clip the micro-clips to the igniter leads Make sure they are not touching any metal or each other Everyone must move away from the rocket.

Put the key in the controller The controller light should glow white A pale yellow light means the batteries are too weak. If the light does not glow the batteries may be installed wrong. Remove the key and check or replace the batteries Repeat Countdown steps

If the light still does not glow the igniter may be broken Remove the key and wait one minute Put a new igniter in the engine. Repeat Countdown steps

ENGINE CODES

Code Color	For Use in Rocket Type
Green	Single Stage
Purple	Top stage multi-stage High performance single stage
Red	Booster stage(s) multi-stage

The code on an Estes engine tells you how powerful it is and how it performs Here's how to read the code

A - Indicates total impulse or power The next "letter" has up to twice the power of the previous letter (Example A "B" engine has up to twice the power of an "A" engine

8 - Shows the engine s average thrust or push in Newtons (Total Impulse/Thrust Duration = Average Thrust)

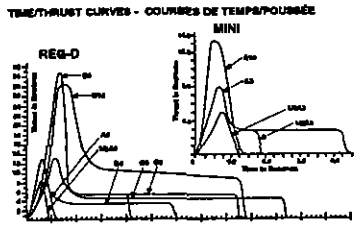
3 - Delay in seconds between the end of thrust and the ejection charge Engine codes ending in "0" have no delay or ejection charge They are usually used only in booster stages Engine codes ending with "T" are mini-engines

Engine/ Moteur	Minimum Total Impulse Newton-Seconds/ Impulsion Totale Minimum Newton-Secondes	Thrust Duration Seconds/ Durée de poussée secondes	Propellant Weight/ Poids de propergol
1/4A3	0 625	0.25	0 83g
1/2A3	1.250	0 3	1 56g
A3	2.500	0 6	3 50g
A10	2.500	0 8	3 76g
A8	2.500	0.5	3 12g
B4	5 000	1 1	6 24g
B6	5 000	0 8	6.24g
C6	10 000	1 6	12 70g
D12	20.000	1 5	24 93g

All values shown may vary up to ± 10%

Toutes les valeurs montrées peuvent changer jusqu' ± à 10%

TIME/THRUST CURVES - COURBES DE TEMPS/POUSSÉE



NAR MODEL ROCKET SAFETY CODE

(Condensed Version)

1 Materials Model rockets will be made of lightweight materials. Fins, nose cones, and/or body tubes will not be made of metal.

2. Motors/Engines Do not alter model rocket engines in any way.

3. Recovery - Use a recovery system that will return a rocket safely Use only flame resistant recovery wadding when required

4 Weight and Power Limits* - Model rockets will weigh no more than the manufacturer's recommended maximum liftoff weight The rocket will weigh no more than 1 500 grams (53 ounces) and the rocket engines will produce no more than 320 Newton-seconds (4.45 Newtons equal 1 pound) of total impulse

5. Stability - Check the stability of the model rocket before its first flight

6 Payloads Except for insects, model rockets will never carry live animals or payloads intended to be flammable explosive, or harmful

7 Launch Site All model rockets will be launched outdoors in a cleared area, free of easy to-burn materials Launch sites will be as large as possible (i.e a football field) (See a detailed safety code for additional parameters)

8 Launcher Launch model rockets from a stable launch device that provides rigid guidance until the model rocket has reached an adequate flight speed and path The launch rod must be capped when not in use. Always use a blast deflector

9. Ignition System Use a remotely controlled and electrically operated launch system All persons should be at least 15 feet (5 meters) away from the launcher when igniting engines totaling 30 Newton-seconds of total impulse or less and at least 30 feet (9 meters) away when igniting engines totaling more than 30 Newton-seconds.

10 Launch Safety Make sure that A People are aware of the upcoming model rocket launch, B Give an audible five-second countdown C Remove the safety interlock or disconnect the battery and wait one minute before approaching a misfire

11 Flying Conditions Launch model rockets in winds less than 20 miles (30 kilometers) an hour Do not launch near aircraft or into clouds

12 Pre-Launch Test Conduct the launching of unproven designs in complete isolation from persons not participat ing in the launch

13 Launch Angle The launch device should be pointed within 30 of vertical

14 Recovery Hazards Do not recover rockets entangled in power lines or other dangerous places A complete version of the NAR Model Rocket Safety Code appears on our web site and is available from Estes

Estes Note* To launch large model rockets weighing more than one lb. (453 g) but no more than 3 3 lbs (1500 g) including propellant or rockets containing more than 4 oz (125g) of propellant (net weight) you must notify and perhaps obtain authorization from the Federal Aviation Administration (FAA) Check your telephone directory for the FAA office nearest you or contact Estes Industries for further information

Estes Rocket Car Racing Safety Code

Read before Racing

Rocket Car - I will only operate my rocket car outdoors according to the instructions I will not alter my rocket car or its parts in any way I will inspect my rocket car after each run and replace any part that is damaged *before* racing again

Engine - I will use *only* the rocket engine recommended for my rocket car I will not alter the rocket engine, its parts or its ingredients in any way

Electrical Ignition - I will *only* ignite my rocket car's engine when it is in the rocket car and the car is fully engaged to the racetrack I will *only* ignite my rocket car's engine with an igniter and the electrical ignition system provided. I will remove the safety key from the system *immediately* after ignition I will *never* ignite the engine when it's not in the rocket car and on the racetrack

Race Line - I will use *only* the race line recommended for my rocket car I will *not* alter the race line in any way I will check the race line after *each* run and replace the *entire* race line if it is damaged in *any* way

Racetrack - I will *always* keep my racetrack line tight so there is never any slack in the line I will inspect my racetrack after *each* run and will repair or replace any parts with wear or damage *before* racing again I will not alter my racetrack in any way

Racetrack Site - I will *only* set my racetrack up outdoors on a smooth, flat surface, free of obstructions, cracks, holes and debris The site will be clear of *all* items that may burn including brown grass and dry weeds I will *not* use ramps or other items with my track that could cause my racer to become airborne I will *not* operate the racetrack in streets, alleys or parking lots that are busy or in areas where prohibited by law My racetrack site will be at least as large as that recommended in the table below

Racetrack Site Requirements

Rocket Car	Engine	Minimum Site Dimensions
Blurzz™ Rocket Racers	A10-0T	120 ft (37 m) x 20 ft (6 m)
Screamin' Eagle™ LSR	D11 – P	550 ft (168 m) x 40 ft (12 m)

Racetrack Safety - I will *not* permit anyone to cross the racetrack while my rocket racer is on the track with engine installed or when running. I will *not* run my Land Speed Racer if the track is wet or if it is windy I will *not* operate my racer in any manner that is hazardous to people, animals or property

Racing - I will make certain *all* persons are at least 15 ft (5 m) away from my racetrack in *all* directions before igniting my racer's engine I will provide an audible signal that the run is about to begin and provide a countdown or advise that the timing lights are working before igniting the engine

Braking - I will not run my rocket car without the drag 'chute braking system correctly attached to the race line After each race I will check the drag 'chute and replace it if it has been damaged I will not alter the braking system in any way

Pledge - As an owner of an Estes® rocket car, I promise to faithfully follow all rules of safe rocket car racing as established in the above safety code

Signature: _____

Important - *Failure to follow the Estes® Rocket Car Racing Safety Code may result in serious injury to you and others as well as cause serious damage to property for which you may be liable Any negligent use of the product may void the warranty and you may be held responsible for all claims*

CONFIDENTIAL

POLY ACETAL

ACETAL

Stiffness and Resilience

The stiffness of Delrin® makes it a leading choice for a material to resist bending under loading Moisture has almost no effect on tensile properties — less than 10 percent change Properties are also good at elevated temperatures A part of Delrin® retains a high degree of strength and stiffness even at 250°F (120°C), which is still 102°F (58°C) below the sharp melting point of Delrin® at 352°F (178°C)

Impact and Fatigue

The fatigue resistance of Delrin® places it in a class by itself among the thermoplastics Its ability to withstand cyclic stressing is outstanding Parts of Delrin® will resist almost indefinitely a completely reversed tensile and compressive stress cycling of 5,000 psi (350 kg/cm^2)

Resistance to single blows or repeated impacting is also outstanding Delrin® acetal resins do not permanently deform or retain dents

Impact resistance varies somewhat among the compositions of Delrin® acetal resin Delrin® 150, the grade of highest molecular weight, gives the toughest parts and should be considered when impact resistance is of prime importance

Delrin® does not depend upon plasticizers for toughness (as do many thermoplastics) and hence does not become brittle at low temperatures Impact resistance of Delrin® at −40°F is only 20 percent less than that at room temperatures The Izod impact values of Delrin® are 20 5 ft lb /inch, unnotched, and 1 4 ft lb /inch for notched samples The difference in values emphasizes the need to eliminate all sharp corners when designing parts

Friction and Bearing Properties

Properly machined parts of Delrin® have a smooth, hard, glossy surface, somewhat slippery to the touch The unlubricated coefficient of friction of a part of Delrin® against steel is low (0 1-0 3), lubricated, the value is even lower (see Table 1)

Unusual is the fact that its static and dynamic coefficients of friction remain virtually unchanged over a wide range of temperatures, bearing loads and relative surface speeds

Abrasion Resistance

Primarily due to the hardness and good frictional properties of Delrin®, parts of Delrin® have excellent abrasion resistance (Table II) Actual or simulated service testing, however, is still the best way to establish the suitability of a material where abrasion and wear resistance are the design requirements

The outstanding performance of Delrin® in nonlubricated gears and bearings, conveyor plates, pump impellers, door closer pistons and business machine parts provides practical evidence of the resin's wear resistance characteristics

COEFFICIENT OF FRICTION
Delrin® ON STEEL, INCLINED PLANE METHOD

CONDITION	COEFFICIENT OF FRICTION Static or Dynamic
Oil Lubricated	
(Viscosity 58 SSU/100°F)	
Maximum	0 1
Minimum	0 05
Water Lubricated	
Maximum	0 2
Minimum	0 1
No Lubricant	
Maximum	0 3
Minimum	0 1

TABLE I

COMPARATIVE WEIGHT LOSS OF VARIOUS MATERIALS IN DIFFERENT ABRASION TESTS

	TABER	BALL MILL	WIRE DRAG	SANDER
Zytel® nylon resin	1	1	1	1
Delrin®	2-5	4-6	5-6	3-4
Polystyrene (several types)	9-26	15-20	35	—
Terpolymer of styrene, butadiene, & acrylonitrile	9	10-20	—	—
Cellulose acetate	9-10	—	—	—
Cellulose acetate butyrate	9-15	10-20	15	—
Methyl methacrylate	2-5	10-20	20	—
Polyvinylidene chloride	9-12	—	—	—
Melamine formaldehyde (molded)	—	15-20	—	—
Phenol formaldehyde (moldings)	4-12	—	—	—
Hard rubber	—	10	—	4
Diecast aluminum	—	11	—	4-5
Mild steel	—	15-20	—	—

TABLE II

Delrin®

When parts of Delrin® are mated with metal parts, a rough surface finish on the metal can affect wear properties A metal surface of 25 micro-inches, rms, is a satisfactory finish, surfaces with less than 16 micro-inches do not appear to have any further beneficial effect

Delrin® acetal resin exhibits clean wearing characteristics and particles from the abrading surface generally are not embedded in the acetal resin

Electrical Properties

Delrin® acetal resin is an excellent dielectric Its dissipation factor and dielectric constant are remarkably low over a wide range of frequencies and temperatures Volume resistivity is high and does not change appreciably due to moisture absorption, as a result, Delrin® retains good electrical properties under conditions of high humidity and after complete immersion in water (Table III)

These desirable electrical properties, plus its exceptionally good mechanical properties, make Delrin® a prime choice for electrical applications where high strength, resistance to abrasion, dimensional stability and good high-temperature performance are required

ELECTRICAL DATA

	ASTM TEST	VALUE
Dielectric constant (73°F and 50% R H)	D150	10^2 cps = 3 74 10^4 cps = 3 71 10^6 cps = 3 69
(73°F @ saturation)	D150	10^4 cps = 3 97
Dissipation factor (73°F and 50% R H)	D150	10^2 cps = 0 0034 10^4 cps = 0 0023 10^6 cps = 0 0048
(73°F @ saturation)	D150	10^4 cps = 0 006
Dielectric strength (short time)	D149	5,870 volts/mil @ 1 2 mils thickness 1,210 volts/mil @ 20 mils thickness 590 volts/mil @ 73 mils thickness
Volume resistivity	D257	$6x10^{14}$ ohm-cm @ 73°F and 0 2% water $2x10^{13}$ ohm cm @ 73°F and saturation
Surface resistivity	D150	10^{14} ohms
Arc resistance	D495	125 seconds to develop hole in 10-mil specimen

TABLE III

Delrin® is resistant* to
Test conditions 9 months at 140°F (60°C) unless noted otherwise

CLASS	MEMBERS TESTED
Aliphatic hydrocarbons	gasoline, kerosene
Aromatic hydrocarbons	benzene, toluene
Alcohols	methanol, ethanol
Ethers	dioxane
Esters	ethylacetate, methyl salicylate
Ketones	acetone
Aldehydes	butyraldehyde
Halogenated hydrocarbons	CC^{14}, Freon® propellant
Cyclic terpenes	turpentine
Fatty oils	linseed oil (12 mos @ 95°F) (35°C)
Fatty acids	oleic acid (12 mos @ 95°F)
Weak organic bases	pyridine, aniline
Amides	dimethyl formamide
Most inorganic salts	10% NaCl, 10% NH_4Cl
Strong detergents	50% "Igepal" (12 mos @ 73°F) (23°C) 100% "Duponol" ME
Mild oxidizing agents	10% potassium permanganate
Weak organic acids	5% acetic, citric (12 mos @95°F)
Dilute bleaches	1 part Chlorox to 200 parts clothes washing solution (2500-5000 washer cycles)

* No gross changes in strength, stiffness, dimensions, weight or appearance, although some slight changes may have occurred in one or more

TABLE IV

Chemical Resistance

Delrin® acetal resins show excellent resistance to organic solvents In fact, there are virtually no common solvents for Delrin® acetal resin at temperatures under 160°F This property, together with low moisture absorption, gives Delrin® excellent room-temperature resistance to staining by foods, industrial oils, greases and typewriter ribbon inks Higher temperatures may cause some slight discoloration

In general, Delrin® has limited use in the presence of strong acids, bases or oxidizing agents For applications in which weak acids, bases or other questionable environments are involved, actual or simulated service tests should be made to determine the feasibility of Delrin® for the particular environment (Tables IV and V)

Tests over a period of years show that Delrin® does not lose its properties when buried under ground — nor is it attacked by fungi, rodents, termites or other insects

HIGH IMPACT POLYSTYRENE

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (linear-flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Comp modulus (10^4 psi) (D695)	Flexural modulus (10^4 psi) (D790)	73°F 125in
PS (GPPS)	IM		GFIR	20			430 480	10 15	1-2		2	80 130	160-167	120-165	90 120		85-110	1 1
PS (GPPS)	IM		GFIR	30			430 480	10 15	0 5 3	90-135	2 2 5	110 150	170-180	120 185	125 150		90-130	1 2
PS (GPPS)	IM		GFIR	35				10 20	0 7			120	170	175	170		140	
PS (GPPS)	IM		GFIR	40			475	10-15	0 5-1		2 5	115 120	175-178	155-190	150-200		140-160	
PS (GPPS)	IM		GFIR	5				10 20	2				135		67		65	
PS (GPPS)	IM		GFL	20			440 470		1			120		180	110		100	
PS (GPPS)	IM		GFL	30			440 470		1			130		200	130		120	
PS (GPPS)	IM		GFL	35			440 470		1			117		210	150		130	
PS (GPPS)	IM		WF	20							8						70	
PS (GPPS)	IM		WF	35							7						93	
PS (GPPS)	IM		WF	50							6						124	
PS (GPPS)	IM	CB							5	28	10						30	2 5
PS (GPPS)	IM	HS			1 4 7		375 500	9-12	4	50 76	2-15	55 78		80-117	31 46		35-50	0 3
PS (GPPS)	IM	IM			5 5-18		380-500	8 20	4-6	32-50	15 30	32 55		55-80	30 39		30-37	
PS (GPPS)	IM	IM	GFIR	10				10 20	2 4						45-56		45-50	
PS (GPPS)	IM	IM	GFIR	20				10-20	2						90		75	
PS (GPPS)	IM	IM	GFIR	30				10-20	2						150		135	
PS (GPPS)	IM	IR			9			10-20	3-6			35		65	35 55		32-54	
PS (GPPS)	IM	IR	GFIR	10				10 20	2						56		50	
PS (GPPS)	IM	IR	GFIR	20				10 20	2						90		75	
PS (GPPS)	IM	L			1 6-17		375-525		3 7	61 70	1 3 85	37-76		94 150	30-46		32-50	0 3 3
PS (GPPS)	IM	LPTFE					475	10 20	5-6			55-60			35-45		30-44	
PS (GPPS)	IM	LPTFE	CFR	30				10-20	1				120		200		140	
PS (GPPS)	IM	LPTFE	GFIR	30			475	15-20	0 5	93-99							110-120	
PS (GPPS)	IM	LS					475	10-20	4-6		3 5	55 90		95	35-36		30-43	
PS (GPPS)	IM	LS	GFIR	30			475	15 20	0 5	93							110	
PS (GPPS)	IM	MR			5 5-10	410 464	392 518		3 6	58 65	1 4 1 6			84 99	46		47-48	
PS (GPPS)	IM	UVS			5 5-9			12 16	4-6	65	1 6	35		65 99	46		32-48	
PS (GPPS)	IM	W			1 6-17		375 525		4-7		1 3-85	37-76		100-150	30-46		32-50	0 3-9
PS (GPPS)	SFM								5-7			25			25		24	
PS (GPPS)	T				1 4 21	410-464	350-530		3 7	35 82	1 5-30	37 82		69-132	25-49		28-48	0 3 0 4
PS (GPPS)	T	MR				410-464	428-518											
PS (HIPS)	BM				2-5		400-475		3 7	34	45	23 69		130	25 37		28-42	2 1
PS (HIPS)	BM	IM			5-7 5							34-41		51-60			31-36	
PS (HIPS)	BM	IR			10 4		425		3-6	34	48	39			29		30	
PS (HIPS)	BM	MR																
PS (HIPS)	CEX				2 3 13 5				3-7	26-45	25 70	24 43		78	22-39		24-43	0 9-3 3
PS (HIPS)	CM				2 6-15 5		425-440		3 7	35 40	20 51	30 58		50-78	32-39		24-43	0 9 2 1
PS (HIPS)	CM	IR			4 5-9 5		430 450		3 6		30-40	27-42					25-28	
PS (HIPS)	EBM				3 9				3-7	37	40	39			34		66	2 1
PS (HIPS),	EX				1 1 8 5	380-425	350 525		3-7	19 50	3-125	19 69		39-130	16 41		20-47	18-4 1
PS (HIPS)	EX		WF	20	1 6	340-370			2 6	29	5 8	33			58		46	
PS (HIPS)	EX		WF	40	0 5	340-370			0 8	42	1 5	42			84		33-36	
PS (HIPS)	EX	IM			2 5-12	390-450	380-500		4 7	32 44	30 65	24 40			16-31		30	
PS (HIPS)	EX	IR			10 4		425		3 6	34	48	39			29		30-34	2 1-2 9
PS (HIPS)	EX	L			2 2 4 5		375 525		4 7		40 65	27-44		70-90	26-32		30-34	2 1 2 9
PS (HIPS)	EX	W			2 2-4 5		375 525		4-7		40-65	27 44		70 90	26-32			
PS (HIPS)	EXF					392 500	464 536											
PS (HIPS)	EXO				3 5		375-525		4-7		65	44			32			
PS (HIPS)	EXO	L			3 5		375-525		4 7		65	44			32			
PS (HIPS)	EXO	W			3 5		375 525		4-7		65	44			32			
PS (HIPS)	EXP				3 5	392 500	375 536		3-7	32 37	40-65	23-44			25 34		28-38	2 1 2 4
PS (HIPS)	EXP	L			3 5		375-525		4 7		65	44			32			
PS (HIPS)	EXP	W			3 5		375 525		4 7		65	44			32			
PS (HIPS)	EXS				2 5 8	392 500	375 536		3-7	23 51	20-65	23 50		44 58	22 34		28-38	1 6 3 3
PS (HIPS)	EXS	IM																
PS (HIPS)	EXS	IR																
PS (HIPS)	EXS	L			3 5		375 525		4 7		65	44			32			
PS (HIPS)	EXS	MR																
PS (HIPS)	EXS	W			3 5		375 525		4 7		65	44			32			
PS (HIPS)	IBM				2 8 8				3 7	26-35	50 60	28 29			24 28		26-31	2 1-3 3

Izod Impact (D256)				Coefficient of linear thermal expansion, flow (in/in-F) (D696)	Rockwell hardness (D785)	Durometer hardness (scale 1) (D2240)	Specific gravity (sp gr 23/23C) (D792)	Water absorption @ 24 hrs (D570)	Water absorption @ equil (D570)	Dielectric strength (V/mil) (D149)	Supplier
73°F 125in	73°F, 25in	40°F 125in	40°F, 25in								
1 1				20-22	85 119		1 1 2	0 07-0 1	0 14		DSM Engineering Plastics LNP Engineering Plastics Inc Prime Source Polymers Inc RTP Co
1 2				18-180	87 121		1 3	0 05-0 1	0 1		DSM Engineering Plastics Ferro Corp LNP Engineering Plastics Inc Prime Source Polymers Inc RTP Co
				19	121		1 3	0 05			RTP Co
				16-17	88-121		1 4	0 05	0 1		LNP Engineering Plastics Inc RTP Co
				33	116		1 1	0 06			RTP Co
	2 5				85		1 2	0 1			DSM Engineering Plastics
	3				90		1 3	0 09			DSM Engineering Plastics
	2 8				90		1 3	0 06			DSM Engineering Plastics
							1 1				HiTech Polymers Inc
							1 2				HiTech Polymers Inc
							1 2				HiTech Polymers Inc
2 5							1 1	0 08			DSM Engineering Plastics
0.3	0 3				82-86		1				BASF Corp Chi Mei Industrial Co Ltd NOVA Chemicals Spartech Compounding
				39	30 112		1 1 3	0 04-0 07			BASF Corp NOVA Chemicals RTP Co Shin A Corp Thermofil Inc
				27			1 1 1 2	0 04-0 08			RTP Co
					117		1 2	0 05			RTP Co
					118		1 3	0 05			RTP Co
					75		1 1-1 2	0 04-0 07			RTP Co Thermofil Inc
							1 2	0 08			RTP Co
							1 3	0 1			RTP Co
0 3-3				75	57-80		1 1 1	0 1			EniChem NOVA Chemicals Spartech Compounding
				36-38	115		1 1-1 2	0 04-0 09			LNP Engineering Plastics Inc RTP Co
				20	121		1 3	0 05			RTP Co
							1 4	0 05			LNP Engineering Plastics Inc
				36-39	105-110		1-1 1	0 04-0 1			LNP Engineering Plastics Inc RTP Co
							1 4	0 05			LNP Engineering Plastics Inc
					80		1	0 1			EniChem
					75-80		1 1 1	0 07			EniChem Thermofil Inc
0 3 3				75	57 77		1 1 1				NOVA Chemicals
							1				Dow Plastics
0 3-0 4				50	55 80		1	0 1	0 1		Amoco Polymers BASF Corp Dow Plastics EniChem
											EniChem
2 1					60		1 1 2				Dow Plastics Fina Oil & Chemical Co
					10-68		1				Dow Plastics Shin-A Corp
							1 2				Dow Plastics
											Dow Plastics
0 9-3 3				50	50-115		1				BP Chemicals Ltd Dow Plastics Fina Oil & Chemical Co
0 9-2 1				43-50	65-115		1				Dow Plastics, NOVA Chemicals
							1 2				NOVA Chemicals
2 1				50	80-110		1				Dow Plastics
1 8-4 1	1 8-4			44 75	12-110		1 1 2	0 05-0 1	0 1		American Polymers Inc Amoco Polymers BASF Corp BASF PS BP Chemicals Ltd Chevron Chemical Co Chi Mei Industrial Co Ltd Dow Plastics EniChem Fina Oil & Chemical Co Kumho Chemicals Inc Network Polymers Inc NOVA Chemicals Shuman Plastics Inc Spartech Compounding
							1 1				North Wood Plastics Inc
							1 2				North Wood Plastics Inc
					44-72		1	0 1	0 1		BASF Corp
							1 2				Dow Plastics
2 1 2 9				75	38 45		1-1 1				NOVA Chemicals
2 1 2 9				75	38 45		1-1 6				NOVA Chemicals
											BASF AG
							1 1				NOVA Chemicals
							1 1				NOVA Chemicals
							1 1				NOVA Chemicals
2 1 2 4				50	60-110		1-1 2				BASF AG, Channel Polymers Dow Plastics NOVA Chemicals
							1 1				NOVA Chemicals
							1 1				NOVA Chemicals
1 6 3 3	1 5			45 50	50 110		1-1 2	0 01-0 1	0 15		BASF AG BASF Corp Dart Polymers Inc Dow Plastics EniChem Modern Dispersions Inc NOVA Chemicals Spartech Compounding
											Dow Plastics
											Dow Plastics
							1 1				NOVA Chemicals
											Dow Plastics
							1 1				NOVA Chemicals
2 1 3 3				50	55-100		1				Dow Plastics

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (linear-flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Compres modulus (10^4 psi) (D695)	Flexural modulus (10^4 psi) (D790)
PS (HIPS)	IM				1 1 16	356-500	350-536	5-40	3 8	21 58	1 4-130	20-69		35-130	16-44		20-47
PS (HIPS)	IM		CFR					10-20	1-3			66-70		95 100	135-145		95-100
PS (HIPS)	IM		GFIR	10					3		3						45
PS (HIPS)	IM		GFIR	20			490		1-2	98 105	3						60-98
PS (HIPS)	IM		GFIR	30	2		490		1 2	110-132	2-3						90-114
PS (HIPS)	IM		GFIR	40					2		2						125
PS (HIPS)	IM		MNF	30			490		2	91	8						103
PS (HIPS)	IM		WF	20	1 6	340-370			2 6	29	5 8	33			58		46
PS (HIPS)	IM		WF	40	0 5	340-370			0 8	42	1 5	42			84		76
PS (HIPS)	IM	CB					490		5	46	2						93
PS (HIPS)	IM	HS			3 8-24		375-500	10-12	6	35	30 50	38-46		64			28-35
PS (HIPS)	IM	HS	GBS	30	4		375-500				33						37
PS (HIPS)	IM	IM			2 5 20	390 450	320-500	5-40	3 7	30 44	30-65	28-51		51-77	20-35		24 71
PS (HIPS)	IM	IM	SSF	10				10-20	4-5						30		30
PS (HIPS)	IM	IR			4-20		320 500	5-40	3-7	33-34	30-80	27-42		47-63	24 29		25-39
PS (HIPS)	IM	L			2 7 13		375 525		4-7		30 75	27 44		60-90	26 32		30-35
PS (HIPS)	IM	L	GBS	30	4		375 500				33						37
PS (HIPS)	IM	LS			24		375 500										
PS (HIPS)	IM	MR			4-5				4-6		30	30 35		55-63			28-30
PS (HIPS)	IM	UVS			5 13		375-500		4-7		30-40	34-35		60			32-36
PS (HIPS)	IM	W			2 7 9		375 525		4-7		40-75	27-44		70 90	26-32		30-34
PS (HIPS)	SFM				15		380 500		3 7	33	30	23 34			24-25		28
PS (HIPS)	SFM	IM			8		380 500		4-7	30	50	32			25		30
PS (HIPS)	SFM	IR			15		380-500		3-7	33	30	34			24		28
PS (HIPS)	T				2 2 13 5		380-500		3 7	23-45	25 70	23 43		50-80	16 39		20-43
PS (HIPS)	T	IM			2 5-3 5	390-450	380-500		4-7	33-44	45 65	24-40			16-31		20-36
PS (HIPS)	T	IR															
PS (HIPS)	T	MR															
PS (IRPS)	BM	IR			7 4 9 3		430 450		3 6	26-30	37-46	28-32			25 26		30-31
PS (IRPS)	EXP	IR			7 4-9 3		430-450		3 6	26-30	37-46	28-32			25-26		30-31
PS (IRPS)	EXS	IR			7 4-9 3		430-450		3-6	26 30	37 46	28-32			25-26		30-31
PS (IRPS)	IM	IR			7 4-9 3		430 450	5-40	3-6	26 37	37-46	28 38			25-26		29-31
PS (Specialty)	EX				3 2 5 5							32 41		38	26		26
PS (Specialty)	IM				5-6 5		420-450		4-8			38-39		50 51	23 29		23-27
PS (XPS)	EX				1 4						2.5						48
PS (XPS)	EX	IM			6 5							35					36
PS Alloy	IM				7 5			10 20	10	16	150	32			11-30		9-28
PS+PE	EX	IM				392 446											
PS+PE	EXF	IM				392-446											
PS+PE	EXS	IM				392-446											
PS+PE	T	IM				392-446											

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—**See ad page A-197**

Petrochemicals (M) Sdn Bhd **P**
PetroHemija **P**
Plastic Resale Corp **C**
Premix Oy **C**
Reter Srl **C**

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★ **SABIC P**
—**See ad page A-195**

Schulman A , Inc **C**
Shuman Plastics Inc **C**
Spartech Color **C**
Spartech Compounding/Color Concentrates **C**
Spartech Compounding Engineered Thermoplastics **C**
Texas Polymer Services Inc A Div of A Schulman Inc **C**
Thai ABS Co Ltd **P**
Thermofil Inc **C,** *Estyrene*
TP Composites Inc **C**
Vamp Tech SpA **C,** *Denistyr Vampstyr*
Visda Inc **C**

POLYVINYL ACETATE

Polyvinyl acetate (PVAC) is available in homopolymer and copolymer versions. PVAC is odorless, colorless, nontoxic and tasteless It is lightweight, has a low burn rate, and minimal water absorption The homopolymer comes in beads, powder, solution, or emulsion forms. Prime plastics applications include adhesives and bases for heat-sealing film

Advanced P...
Air Products ...
BTL-Specialty P...
Fuller H B Co
General Latex ...
Hampshire C ...
Daratak Eve...
National Starch
Reichhold P, P...
Scott Bader Co
Soluia Inc P, ...
StanChem Inc
Texas Polymer
Union Carbide ...
Wacker Polymer...

Izod impact (D256)				Coefficient of linear thermal expansion, flow (in/in-F) (D696)	Rockwell hardness (D785)	Durometer hardness (scale 1) (D2240)	Specific gravity (sp gr 23/23C) (D792)	Water absorption @ 24 hrs (D570)	Water absorption @ equil (D570)	Dielectric strength (V/mil) (D149)	Supplier
73°F 125in	73°F, .25in	40°F 125in	40°F, .25in								
0 9-5 5	1-1 6	1		36-75	25-115		0 9-1 2	0 03-0 1	0 1-0 15		American Polymers Inc Amoco Polymers BASF AG BASF Corp BASF PS BP Chemicals Ltd , Cheil Industries Inc Chi Mei Industrial Co Ltd Dart Polymers Inc Dow Plastics EniChem Fina Oil & Chemical Co Kumho Chemicals, Inc M Holland Co , Network Polymers Inc , NOVA Chemicals RTP Co Shuman Plastics Inc , Spartech Compounding United Composites Inc
				25-26			1 1	0 6			RTP Co
					110		1 1				Prime Source Polymers Inc
					110-119		1 2				ComAlloy International Corp Prime Source Polymers Inc
				18	115-119		1 3				ComAlloy International Corp Prime Source Polymers Inc
					118		1 4				Prime Source Polymers Inc
					112		1 3				ComAlloy International Corp
							1 1				North Wood Plastics Inc
							1 2				North Wood Plastics Inc
					107		1 1				ComAlloy International Corp
1 6 1 8	1 4-1 6				77-80		1				Chi Mei Industrial Co Ltd NOVA Chemicals Spartech Compounding
							1 3				Spartech Compounding
2				36	10-72		1 1 2	0 06-0 1	0 1		American Polymers Inc BASF Corp Dow Plastics, Polymerland Inc RTP Co Shin-A Corp Thermofil Inc
							1 1	0 1			RTP Co
1 6-2 3	1 1 1 5				46-98		1 1 2	0 06-0 07			BASF Corp Cheil Industries Inc Chi Mei Industrial Co Ltd Dow Plastics NOVA Chemicals Polymerland, Inc Spartech Compounding Thermofil Inc
2 1-2 6				75	40-70		1-1 1	0 07			NOVA Chemicals Spartech Compounding Thermofil Inc
							1 3				Spartech Compounding
											Spartech Compounding
					46-60		1 1 2	0 07			Dow Plastics, Thermofil Inc
2					70		1-1 1	0 07			Polymerland Inc , Spartech Compounding Thermofil Inc
2 1-2 6				75	40-45		1-1 1				NOVA Chemicals
							1 1 2		0 15		BASF Corp Dow Plastics
					60		1	0 1	0 1		BASF Corp
							1 2				BASF Corp
0 9-3 3	1 5			45-50	42 115		1 1 1	0 01	0 1		American Polymers Inc BASF Corp Dart Polymers Inc Dow Plastics Fina Oil & Chemical Co Modern Dispersions Inc NOVA Chemicals
					44-58		1	0 1	0 1		BASF Corp Dow Plastics
											Dow Plastics
											Dow Plastics
2 3 2 4				42			1 2				Dow Plastics
2 3-2 4				42			1 2				Dow Plastics
2 3-2 4				42			1 2				Dow Plastics
2 3 2 4				42	61		1 2				Dow Plastics M Holland Co
1-3 1					50		1				Chevron Chemical Co
					55 95		1				Chevron Chemical Co
							1				NOVA Chemicals
2							1 1				Polymerland Inc
				60			1-1 1	0 5			Dow Plastics RTP Co
											EniChem
											EniChem
											EniChem
											EniChem

Polyvinyl acetate (PVAC)

- Advanced Polymer Compounding Co **C**
- AT Products and Chemicals Inc **P**, *Vinac*
- BTL Specialty Resins Corp **P**
- Bostik H B Co **P**
- Chemical Latex & Chemical Corp **C**, *Vult Acet*
- Hampshire Chemical Corp Subs of Dow Chemical Co **P**, *Daratak Everflex*
- National Starch and Chemical Co **P**, *Duro O Set Resyn*
- Reichhold **P**, *Plyamul*
- Scott Bader Co Ltd **P**
- Solutia Inc **P**, *Gelva*
- UniChem Inc **P**
- Texas Polymer Services Inc A Div of A Schulman Inc **C**
- Union Carbide Corp **P**
- Wacker Polymer Systems **P**

POLYVINYL ALCOHOL

Polyvinyl alcohol is produced from the full or partial hydrolysis of a vinyl ester such as vinyl acetate The reaction results in the replacement of some or all of the acetyl groups with hydroxyl groups Polyvinyl alcohol (PVOH), is a crystalline thermoplastic powder that is soluble in water and alcohol The resin's barrier properties suit it for use in packaging films, hoses, and tubing, where in its fabricated form PVOH is impermeable to oxygen and nitrogen, and is unaffected by grease, oils, waxes, and organic solvents, other than alcohol When PVOH film is stretch oriented, it achieves crystallinity which permits it to polarize light Hydrolysis levels in

POLY PROPYLENE

Resin & Compound

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (linear-flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Comp modulus (10^4 psi) (D695)	Flexural modulus (10^4 psi) (D790)	73°F 125in
PP	BM				0 5-9		450-525				1000	29 50			1 21		14-31	
PP	BM		CCF	10	8				11	36							22	
PP	BM		CCF	20	8-16				12	37							26	
PP	BM		CCF	30	8				12	36							31	
PP	BM		CCF	40	2-16				10-11	32 35	170	33					35-36	
PP	BM		CSF	40	3				9			40					59	
PP	BM		GFIR	20	8				4	69				84			38	1 7
PP	BM		GFIR	30	8				2	91				107			68	1 6
PP	BM		GFIR	40	8				1 5	110				116			88	1 5
PP	BM		MNF	20	3				9			50					50	
PP	BM		MNF	40	3				6			53					77	
PP	BM		TF	10	3				13			43					27	
PP	BM		TF	20	3-16				12	40		41					29-32	
PP	BM		TF	30	3				11			39					37	
PP	BM		TF	40	3-16				10-11	38		38					40-42	
PP	BM	UVS																
PP	CAL				0 8-9		482			26	800-1000	10			1			
PP	CAL	HS					482											
PP	CEX				0 2							53			22		22	
PP	CEX	ABU																
PP	CEX	SU																
PP	CM				0 5 0 6							36-46			14 17			
PP	CM		GFIR	30					1 3	120	2 2		140		70		74	
PP	CM		GFIR	40					1-3	145	2		200		90		89	
PP	COT						482											
PP	EBM				8 9						1000				1			
PP	EX				0 2 35		450-525		1 25	32 50	100-920	26 90		30-60	11-25		8 56	
PP	EX		CCF				400-450					22 35		28 50	20 42			
PP	EX		CCF	30	15				11			32					18 35	
PP	EX		CCF	40	0 9 2				10		170	30-33					28	
PP	EX		CCF	43	3				12 14		40	35		60			18-36	
PP	EX		MCF				400-450		8-10			40-54		55 81	61 70		41	
PP	EX		MNF		1-1 5				9-12			27-31					55-75	
PP	EX		MNF	26	3				6-10		11	41		60			34-40	
PP	EX		TF				400 450					25-41		34			37	
PP	EX		TF	20	0 8 3				11 18		27-146	47		73			25-47	
PP	EX		TF	21	0 7				12-15		50	39		58			38-41	1 4
PP	EX		TF	38	0 8				11-13		5	52		85			25	
PP	EX		TF	40	1 12						48	46					68	
PP	EX	HS			2 4		482				250	38					43	1 1
PP	EX	IM			2		400-440		14-20			36-44					16	
PP	EX	IR			2 4						250	38					15-18	0 9 2 7
PP	EX	SU					482										16	
PP	EX	UVS			2		400 482		14-20			42					16	2 1
PP	EX	UVS	TF	20	0 8						146	47					41	1 4
PP	EXB				3 29				2-15		3 600						2 78	
PP	EXB		CCF		28				13-15		90						22	
PP	EXB		GFIR		2-11				1 12		3 24						25-137	
PP	EXB		GMN		9-17				1 8		7 9						61-90	
PP	EXB		MNF		1 20				6 13		3 5-500						15-67	
PP	EXB	IM			4				2-8		6						62	
PP	EXC				9-72						200	33 48					9-19	0 4 0 7
PP	EXF				4		450-525				100	48			19		19	
PP	EXF	UVS					482											
PP	EXP				0 6-29		482		2 15		3 1000	35 49		46	1-13		2 78	
PP	EXP		CCF		28				13 15		90						22	
PP	EXP		CCF	43	3				12 14		40	35		60			41	
PP	EXP		GFIR		2 11				1 12		3 24						25 137	
PP	EXP		GMN		9 17				1 8		7 9						81 90	
PP	EXP		MNF		1-20				6-13		3 5 500	27 31					15-67	
PP	EXP		TF	20	5				11 15		30	33		53			25	

Compres modulus (10^4 psi) (D695)	Izod Impact (D256) 73°F 125in	73°F, 25in	40°F 125in	40°F, 25in	Coefficient of linear thermal expansion, flow (in/in-F) (D696)	Rockwell hardness (D785)	Durometer hardness (scale 1) (D2240)	Specific gravity (sp gr 23/23C) (D792)	Water absorption @ 24 hrs (D570)	Water absorption @ equil (D570)	Dielectric strength (V/mil) (D149)	Supplier
					83	80 98	85 89	0 9 1				A Schulman Inc Epsilon Products Co Huntsman Polymers Corp PCD Polymere GmbH Phillips Sumika Polypropylene Co Plastic Selection Group Inc , Ticona
						86		1				The Plastics Group
						86		1				The Plastics Group
						86		1 1				The Plastics Group
						87 96		1 2				The Plastics Group Washington Penn Plastic Co Inc
						87		1 2				The Plastics Group
	1 7							1				The Plastics Group
	1 6							1 1				The Plastics Group
	1 5							1 2				The Plastics Group
						95		1				The Plastics Group
						95		1 2				The Plastics Group
						87		1				The Plastics Group
						87		1				The Plastics Group
						87		1 1				The Plastics Group
						87 88		1 2				The Plastics Group
												PCD Polymere GmbH
							85 89	0 9				Huntsman Polymers Corp Montell U SA Inc PCD Polymere GmbH
												PCD Polymere GmbH
						100		0 9				Plastic Selection Group Inc Solvay Polymers Inc
												Solvay Polymers Inc
												Solvay Polymers Inc
					63			0 9				Ticona
					15			1 1				GE Plastics
								1 2				GE Plastics
												PCD Polymere GmbH
							85-89					Huntsman Polymers Corp
					31-83	65 105		0 9-1 4	0 01 0 03			A Schulman Inc Epsilon Products Co Equistar Chemicals LP Exxon Chemical Co Huntsman Polymers Corp , LNP Engineering Plastics Inc Multibase Inc PCD Polymere GmbH Phillips Sumika Polypropylene Co Plastic Selection Group Inc Polipropileno de Venezuela Propilven SA RTP Co Solvay Polymers Inc Ticona
18-35		1				82 88		1 2-1 3	0 01-0 05			DSM Engineering Plastics
								1 1				Multibase Inc
18-36								1 2				Multibase Inc Washington Penn Plastic Co Inc
								1 3				Ferro Corp
35-75		0 6-1						1 2-1 3	0 03			DSM Engineering Plastics
34-40								1 2				Equistar Chemicals LP
												Ferro Corp
26-47		0 6-4 2						1 2	0 06			DSM Engineering Plastics
38-41	1 4							1 1 1				Ferro Corp Washington Penn Plastic Co Inc
35								1				Ferro Corp
38								1 2				Ferro Corp
43	1 1							1 2				Washington Penn Plastic Co Inc
16								0 9				PCD Polymere GmbH, Washington Penn Plastic Co Inc
15-18	0 9-2 7					72 84						Huntsman Polypropylene Corp
16								0 9				Washington Penn Plastic Co Inc
												PCD Polymere GmbH
16	2 1					81						Huntsman Polypropylene Corp PCD Polymere GmbH
41	1 4							1				Washington Penn Plastic Co Inc
2-78					17-61	84-93		0 9-2 1				PolyPacific Australia Pty Ltd
22					44			1 1				PolyPacific Australia Pty Ltd
25-137					17-33			0 9 1 3				PolyPacific Australia Pty Ltd
61-90					17 22			1 1-1 2				PolyPacific Australia Pty Ltd
15-67					33 50	88 106		0 9 1 3				PolyPacific Australia Pty Ltd
82					17			1 1				PolyPacific Australia Pty Ltd
9 19	0 4 0 7					70 100		0 9				Chisso America Inc Huntsman Polypropylene Corp
19						85						Huntsman Polymers Corp PCD Polymere GmbH
												PCD Polymere GmbH Targor
2 78					17-61	60 93	85 89	0 9 2 1	0 01			Huntsman Polymers Corp Modern Dispersions Inc , PCD Polymere GmbH PolyPacific Australia Pty Ltd Solvay Polymers Inc Union Carbide Corp Polymers Group
22					44			1 1				PolyPacific Australia Pty Ltd
41								1 3				Ferro Corp
25 137					17 33			0 9 1 3				PolyPacific Australia Pty Ltd
61-90					17-22			1 1 1 2				PolyPacific Australia Pty Ltd
15-67					33 50	88 106		0 9 1 3				Equistar Chemicals LP PolyPacific Australia Pty Ltd
25								1 1				Ferro Corp

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (linear-flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Compr modulus (10^4 psi) (D695)
PP	EXP	HS					482									
PP	EXP	IM			4				2-8		6					
PP	EXP	UVS					482									
PP	EXS				0 6 13 6					25-26	17 6-1000	10-49			1-13	
PP	EXS		MNF		1				9-12			31				
PP	EXS		UN	30	1 2				10		36	44		64		
PP	EXS	HS					482									
PP	EXS	IM			0 5						200	44				
PP	EXS	UVS					482									
PP	FB				0 8-10						200-400	51				
PP	FB	IM			8						200	35				
PP	FC				5-35						200	36 51				
PP	FC	IM			7						200	41-44				
PP	FCX				2 8							34				
PP	FP				8-9						1000	1	0		1	
PP	FP		GFIR	20			390 450		3			48		70	40	
PP	IM				0 3-90		325 525	0 3-25	1-25	10-50	1 5-1000	4-90	35 68	35-70	1 25	
PP	IM		AF	15			400-440		6-7	35	3				30	
PP	IM		BS	60			420-460		12	35	1 5				50	
PP	IM		CCF		14-28		400-450	7-10	11 15		90	22-39	70	28-60	20-35	
PP	IM		CCF	10	4-20			7-16	11-25	36	50-220	31-45	68	44-67	28	
PP	IM		CCF	12	12				14		450	41		57		
PP	IM		CCF	15	27											
PP	IM		CCF	20	4-28		400-460	0 8-16	12-20	37-42	30-260	28-46	40-69	40-70	25 34	
PP	IM		CCF	21	23-28				12-14		44-150	27 44		41-67		
PP	IM		CCF	22	15-27				12-14		35 230	24 45		36-71		
PP	IM		CCF	23	12 25				13 14		25 60	22-45		34-66		
PP	IM		CCF	25	8 18				9 13		65 150	30-42		55 65		
PP	IM		CCF	30	8 25		400-450	7-16	4 18	36	36 500	22-58	70	29-78	30-60	
PP	IM		CCF	31	1 4				15		125	35		56		
PP	IM		CCF	35	10 23				14		30-180	28-41		48-68		
PP	IM		CCF	40	0 9-20		400 450	7-16	9-14	32 35	15-1000	23-35	40-72	37-70	35-42	
PP	IM		CCF	45	18				9			27		52		
PP	IM		CCF	50	11				10		35	31		58		
PP	IM		CCF	6	12				16		100	43		45		
PP	IM		CCF	60	10							26		50		
PP	IM		CFN	15			420-460		10-20	40	3				45	
PP	IM		CFR	10			390-550		3 8	76	5	36		53-90		
PP	IM		CFR	20			440 475		1 5	100-101	2 2 5			115-156		
PP	IM		CFR	30			390-550		1-4	115	2 5	70		90-125	175	
PP	IM		CSF	40	3			12-16	9			40				
PP	IM		GBS		6		390 540	5-10	4-6		3	56-80	57 84	80-115	60-85	
PP	IM		GBS	10				5-10	14-23			40	45	50	22	
PP	IM		GBS	20				5-10	20			38	44	50	27	
PP	IM		GBS	30			400 440	5-10	9 18	65	2	35	42	47	30 55	
PP	IM		GBS	40			420 460	5 10	9-16	50	2	30	39	45	32-60	
PP	IM		GFIR		2 11		400	5-10	1 12		3-24	56-88	59 84	90-123	60-85	

Flexural modulus (10^4 psi) (D790)	h 73°F 125in
62	
14-24	0 8
34	
27	
16	
19	
11	
11-20	0 4
12 15	
10	
40	
2-78	0 5 1 8
30	
18-30	
18-25	0 6 2
23	
18	
16-31	0 7-1 8
17 26	
15-30	
16-26	
19-33	
14-52	0 6-2
24	
23-35	
18-36	0 8 2 6
38	
40	
13	
45	
45	
34-63	
80-118	
110-165	
36	
45-66	
18	
22	
21-55	
28-60	
21-137	3

Compressive modulus (10^4 psi) (D695)	Flexural modulus (10^3 psi) (D790)	Izod impact (D256) 73°F 125in	73°F, .25in	40°F 125in	40°F, .25in	Coefficient of linear thermal expansion, flow (in/in-F) (D696)	Rockwell hardness (D785)	Durometer hardness (scale 1) (D2240)	Specific gravity (sp gr 23/23C) (D792)	Water absorption @ 24 hrs (D570)	Water absorption @ equil (D570)	Dielectric strength (V/mil) (D149)	Supplier
													PCD Polymere GmbH
						17			1 1				PolyPacific Australia Pty Ltd
													PCD Polymere GmbH
	24	0 8					60-80	85-89	0 9-1 4				Chisso America Inc Huntsman Polymers Corp , M A Hanna Engineered Materials Montell U SA Inc , Solvay Polymers Inc Union Carbide Corp Polymers Group
									1 2				Equistar Chemicals LP
									1 1				Ferro Corp
													PCD Polymere GmbH
							85		0 9				Chisso America Inc
													PCD Polymere GmbH
							100		0 9				Chisso America Inc Montell U SA Inc
							80		0 9				Chisso America Inc
	120	0 4					75-100		0 9				Chisso America Inc Huntsman Polypropylene Corp Montell U SA Inc
	15						85-88		0 9				Chisso America Inc
									0 9				Equistar Chemicals LP Montell U SA Inc
								85 89	0				Huntsman Polymers Corp NOVA Chemicals
			0 8						0 8				DSM Engineering Plastics
	78	0 5-1 8	0 4			17-83	53-112	85-89	0 7 3 2	0 005-1			A Schulman Inc BASF AG Chisso America Inc Color & Composite Technologies Inc DSM Engineering Plastics, Epsilon Products Co Equistar Chemicals LP, Ferro Corp Formosa Plastics Corp USA Huntsman Polymers Corp Huntsman Polypropylene Corp KW Plastics LNP Engineering Plastics Inc M A Hanna Engineered Materials, Modern Dispersions Inc , Modified Plastics Montell U SA Inc Muehlstein Compounded Products Multibase Inc PCD Polymere GmbH Phillips Sumika Polypropylene Co Plastic Selection Group Inc Polipropileno de Venezuela Propilven SA PolyPacific Australia Pty Ltd RheTech RTP Co Solvay Polymers Inc Ticona Tong Yang Nylon Co Ltd TP Composites Inc Union Carbide Corp Polymers Group
	30								1 1	0 01			M A Hanna Engineered Materials
									1 7				M A Hanna Engineered Materials
	18-30					44	97		1 1-1 2	0 02 0 05			DSM Engineering Plastics Multibase Inc PolyPacific Australia Pty Ltd RTP Co
	18-25	0.6-2				37	82 86		1	0 01			Ferro Corp Multibase Inc RheTech RTP Co The Plastics Group
	20								1				Multibase Inc
	28								1				Muehlstein Compounded Products
	18-31	0 7-1 8	0 9			32-35	78-94		1 1 1	0 02			DSM Engineering Plastics Ferro Corp , M A Hanna Engineered Materials Multibase Inc RheTech RTP Co The Plastics Group
	17-28								1 1				Ferro Corp
	15-30								1 1				Ferro Corp Muehlstein Compounded Products
	16-26								1 1				Ferro Corp Muehlstein Compounded Products
	19-33								1 1				Ferro Corp Multibase Inc
	14-52	0 6-2				30	86-94		1 1 1 2	0 02			DSM Engineering Plastics Ferro Corp Multibase Inc RheTech RTP Co The Plastics Group Washington Penn Plastic Co Inc
	24								1 1				Ferro Corp
	23-35								1 2				Ferro Corp
	18-36	0.8-2 6	1 1			28	83-99		1 2 1 3	0 02 0 1			DSM Engineering Plastics Ferro Corp Multibase Inc RheTech RTP Co The Plastics Group
									1 4				Multibase Inc
	30								1 4				Ferro Corp
	13								0 9				Multibase Inc
	26								1 6				Ferro Corp
	45								1				M A Hanna Engineered Materials
	34-63								0 9	0 01			DSM Engineering Plastics LNP Engineering Plastics Inc
	80-118						95		1	0 01	0 01		LNP Engineering Plastics Inc Nytex Composites Co Ltd (USA)
	110-165								1 1	0 02-0 12	0 02		DSM Engineering Plastics LNP Engineering Plastics Inc
	28						87		1 2				The Plastics Group
	45-66					21-32	100		1 1 1 2	0 02-0 06			Albis Canada Inc RTP Co
	19					38	82		1	0 01			RTP Co
	22					37	90		1	0 02			RTP Co
	25-65					36	94		1 1	0 02			M A Hanna Engineered Materials RTP Co
	28-60					35	96		1 2	0 03			M A Hanna Engineered Materials RTP Co
	25-137	3				17 33	100 110		0 9 1 5	0 02 0 03			DSM Engineering Plastics PolyPacific Australia Pty Ltd RTP Co Tong Yang Nylon Co Ltd

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (linear-flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Compr modulus (10^4 psi) (D695)	Flexural modulus (10^4 psi) (D790)
PP	IM		GFIR	10	2 4		385-475	0 6 10	3 10	35 67	2 12	30 80	60 76	60-110	29-80		25-80
PP	IM		GFIR	11			510		10	66	8 3						26
PP	IM		GFIR	13	2			0 7 1 2	5		5	60		70			38
PP	IM		GFIR	15	5-12			0 4 10	2 5-7			36-65	70-73	84-97	62-130		20-90
PP	IM		GFIR	20	2 5-19		385 540	0 1-16	2-6	69-102	2 7	39 115	60 97	40 140	38-90		17 75
PP	IM		GFIR	23	5			12 16	3 4			88 97		130 135			57
PP	IM		GFIR	25	2 7			5-10	2-7		4	58-100	80	90 140	86		40-62
PP	IM		GFIR	30	2 9		385-540	0 6 16	0 0025-6	75 114	1 3 17	42-165	84-120	60-185	41-120		40-90
PP	*IM*		*GFIR*	35	3		*510*	*5-16*	*2-4*	*118*	*4 5*	*80-135*	*87*	*100-200*	*125*		*85-90*
PP	IM		GFIR	40	2-22		385 510	5 16	0 8 50	70-133	1 5 4 4	23 150	89 130	55-220	39 150		36-113
PP	IM		GFIR	42	14				50			36		60			45
PP	IM		GFIR	43					0 0001 2								100
PP	IM		GFIR	5				10-20	8						30		23
PP	IM		GFIR	50			510		1	131 155	2-3 5						131 134
PP	IM		GFL	30			370 390			156	2 4	106	122-144	191	81-93		73-75
PP	IM		GFL	40			380-450	10-20	1-3 5	175	2 5	100-167	135 159	155-260	98 140		95 120
PP	IM		GFL	50			390-450	10 20	1-2			110-185	125 171	160-274	130-150		120-150
PP	IM		GMC	30					4		2 5	60					65
PP	IM		GMN		9 17			5-10	1-8		7 9	56 80	57 84	80 115	60 85		45-90
PP	IM		GMN	25													50
PP	IM		GMN	30	4 4-5 5		510		3 5	97	4	95		130 140			65-84
PP	IM		GMN	32				0 7 1 2									63
PP	IM		GMN	35													54-71
PP	IM		GMN	36													23-64
PP	*IM*		*GMN*	*40*	*5*		*510*	*12-16*	*3-4*	*89 138*	*2 6-3 8*	*90*		*143*			*86-102*
PP	IM		GMN	45			510		4	102	3 1						69
PP	IM		GMN	50			510		5	66	4						44
PP	IM		MCF					7 10	10-16			46	62	75	60		50
PP	IM		MCF	12	7				11-12		25	38		62			18-30
PP	IM		MCF	15	8 5				10			50		78			23-32
PP	IM		MCF	18	6 3						15	45					41
PP	IM		MCF	20	5-28			0 7-1 4	8 9			44-49		80			25-47
PP	IM		MCF	25				7 10	10 16			46	62	75	60		23-50
PP	IM		MCF	30													23
PP	IM		MCF	33													38
PP	IM		MCF	40	5-12		460-500	7 10	6-9		3-8	45-59	70	74-85	110		45-84
PP	IM		MCF	50	12				5			120					110
PP	IM		MNF		1-20		390-450	5 10	6 14		3 5 500	25 34		48 56	55		15-67
PP	IM		MNF	10				5 10	3-5			85		125	90		65
PP	*IM*		*MNF*	*13*													*22 26*
PP	IM		MNF	15													22
PP	IM		MNF	20	3-20		385 510	5-16	5 15	25-43	74 3	50 52	60	87	80		18-60
PP	IM		MNF	21				0 7 1 2									17
PP	*IM*		*MNF*	*22*								45		*70*			*30-38*
PP	IM		MNF	25	10 14			5 10	3 10			38 61	70	97	130		22 90
PP	IM		MNF	27	14							34		50			20
PP	IM		MNF	28	20				9			36					26
PP	IM		MNF	30	14-20		410 450		10 12		9 32	32 45		65-70			21-37
PP	IM		MNF	39													33
PP	IM		MNF	40	3 13		400 510	7 16	6 70	27	6 1	29 53	70	68 70	34 75		28-68

Izod Impact (D256)				Coefficient of linear thermal expansion, flow (in/in-F) (D696)	Rockwell hardness (D785)	Durometer hardness (scale 1) (D2240)	Specific gravity (sp gr 23/23C) (D792)	Water absorption @ 24 hrs (D570)	Water absorption @ equil (D570)	Dielectric strength (V/mil) (D149)	Supplier
73°F 125in	73°F, .25in	40°F 125in	40°F, 25in								
1-2 2	0 5 3	1 3		20-31	38-110		0 8 1 5	0 01 0 04			A Schulman Inc DSM Engineering Plastics Ferro Corp Huntsman Polypropylene Corp LNP Engineering Plastics Inc M A Hanna Engineered Materials Multibase Inc Polycom Huntsman Inc RheTech RTP Co
					89		1		0 3		ComAlloy International Corp
1							1				Ferro Corp RheTech
				21 28	87 94		1 1 3	0 01 0 03			Multibase Inc , RheTech RTP Co
1 5-2 5	0 8 3 3	1 7		16-26	45-112		0 8-1 5	0 01-0 05	0 02 0 3		A Schulman Inc Albis Canada Inc ComAlloy International Corp DSM Engineering Plastics, Ferro Corp Huntsman Polypropylene Corp , LNP Engineering Plastics Inc Multibase Inc Nytex Composites Co Ltd (USA) Polycom Huntsman Inc RheTech RTP Co The Plastics Group Thermofil Inc TP Composites Inc
				23	94		1 1	0 03			Thermofil Inc
1 1				23	93 110		1 1	0 02			Ferro Corp RTP Co
1 2 8	0 9-3 6			12 22	53-112		0 9-1 5	0 01 0 05	0 05 0 3		A Schulman Inc Albis Canada Inc ComAlloy International Corp DSM Engineering Plastics Ferro Corp Huntsman Polypropylene Corp LNP Engineering Plastics Inc M A Hanna Engineered Materials Multibase Inc , Nytex Composites Co Ltd (USA) Polycom Huntsman Inc RheTech RTP Co The Plastics Group Thermofil Inc TP Composites Inc
				20-21	95 110		1 2	0 02-0 04	0 3		ComAlloy International Corp Ferro Corp RTP Co Thermofil Inc
1 2-3 2	0 9-3 8			15 18	59-112		1 1 2	0 01 0 06	0 09-0 3		A Schulman Inc ComAlloy International Corp DSM Engineering Plastics Ferro Corp LNP Engineering Plastics Inc Multibase Inc Polycom Huntsman Inc RheTech RTP Co The Plastics Group TP Composites Inc
							1 3				Multibase Inc
							1 3				RheTech
				30			1	0 015			RTP Co
					109-110		1 3		0 3		ComAlloy International Corp
							1 1				Ticona
5		3 9			98-105		1 2	0 04 0 06			DSM Engineering Plastics LNP Engineering Plastics Inc Nytex Composites Co Ltd (USA) RTP Co Ticona
5 5				16	102-105		1 3	0 04-0 07			DSM Engineering Plastics LNP Engineering Plastics Inc RTP Co Ticona
							1 1				Polycom Huntsman Inc
				17 32	100		1 1 1 2	0 02-0 08			PolyPacific Australia Pty Ltd RTP Co
							1 1				RheTech
					106		1 1 1 2		0 3		ComAlloy International Corp Ferro Corp
							1 1				RheTech
							1 2				RheTech
							1 2				RheTech
				25	100-108		1 2 1 3	0 05	0 3		ComAlloy International Corp RheTech Thermofil Inc
					106		1 2		0 3		ComAlloy International Corp
					86		1 2		0 3		ComAlloy International Corp
				28	93		1 1	0 02			RTP Co
							1				Ferro Corp RheTech
							1				Multibase Inc RheTech
							1				Washington Penn Plastic Co Inc
							1 1 1	0 03			Ferro Corp Multibase Inc RheTech
				28	93		1 1	0 02			RheTech RTP Co
							1 1				RheTech
							1 1				RheTech
				22	96 99		1 2 1 3	0 03			Ferro Corp , Multibase Inc , RheTech RTP Co TP Composites Inc
							1 3				Multibase Inc
				28-50	88 106		0 9-1 4	0 02			Equistar Chemicals LP Multibase Inc PolyPacific Australia Pty Ltd RTP Co , Tong Yang Nylon Co Ltd
				26			1 1	0 03			RTP Co
							1				RheTech
							1				RheTech
				25	93-98		1-1 1	0 01	0 3		A Schulman Inc ComAlloy International Corp RheTech RTP Co The Plastics Group
							1 2				RheTech
							1-1 1				RheTech
				21	94		1 1 1 3	0 01			Multibase Inc RheTech RTP Co
							1 1				Multibase Inc
							1 1				Multibase Inc
				30			1 1 1 2	0 05			Equistar Chemicals LP Ferro Corp Multibase Inc RheTech
							1 2				RheTech
0 7				27	82-102		1 2-1 3	0 03	0 3		ComAlloy International Corp DSM Engineering Plastics M A Industries Inc Multibase Inc RheTech RTP Co The Plastics Group

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (linear-flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres. strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Compr. modu (10^4 ps (D695	Flexural modulus (10^4 psi) (D790)	73°F (23°
PP	IM		MNF	45	16				8		10	36		62			42	
PP	IM		MNF	8													28	
PP	IM		SSF	15				10-20	1-1 5						20		16	
PP	IM		SSF	6					5-6			40		62	24		15	
PP	IM		SSFL	5					20			43		480			20	
PP	IM		TF		4 5		350-450		10-14			46-49					24-45	0 7
PP	IM		TF	10	3 11			0 7-16	9 22		50	35-56	38 68	45-80	30-40		20-35	0 6-2
PP	IM		TF	13	7-13				14-15		20-26	50-51		73 75			28-30	
PP	IM		TF	15	15				11		100	32					26	2 8
PP	IM		TF	20	3-16		385 475	0 7-16	8 20	40	15 50	34-54	39-69	50-82	34-45		27-49	
PP	IM		TF	21	0 7				12 15		50	39		58			25	
PP	IM		TF	22	17									60			34	
PP	IM		TF	25	18				8			43					32	
PP	IM		TF	30	3-18			7-16	8 5-16		8-22	37-54	72	57-78	50		30-40	0 3-0
PP	IM		TF	35	5				10			46		78			40	
PP	IM		TF	39	15						15	47					50	0 5
PP	IM		TF	40	1 4-20		420-500	7-16	7 12	38 50	2-10	33-53	45-75	60 90	45-68		30-60	
PP	IM		TF	42	8				7-11		6	31		51			40	
PP	IM		UN		5 6		390-450		1-5			88-130					60-110	
PP	IM		UN	13	20												30	
PP	IM		UN	15	15-15 1												23	
PP	IM		UN	20	13-35												18-34	
PP	IM		UN	23													30	
PP	IM		UN	25	12												26	
PP	IM		UN	40	15				12								45	
PP	IM		WOL	10													30	
PP	IM	AS			10-60		482	10-20	15-20		20-200	33-51		51	25		14-26	2 3
PP	IM	CB					400-460		1 7-22	30-39	3 5-300	30-35		40-45	12-33		14-33	
PP	IM	CB	CCF	15					12	30	20						20	4
PP	IM	CB	CCF	20					12	42	6				40		40	0 7
PP	IM	CB	GBS					5 10	10-14			28		50	40		35	
PP	IM	CB	GFIR	25			440		7-10			40		55			47	
PP	IM	CB	GFIR	5			380-440		7-9	37	2				45		45	
PP	IM	CB	MCF	20			440		13-16			31		47			32	
PP	IM	CB	MNF					5-10	10-14			28		50	40		35	
PP	IM	CB	MNF	20			380-440		7-9	38	3 5				45		45	
PP	IM	HS			2 4		440-482	15-20			250	38-40					16-17	
PP	IM	HS	CHF	30			482											
PP	IM	HS	CHF	40			482											
PP	IM	HS	GFIR	10					6-7	82	3	87					39-50	1-1 5
PP	IM	HS	GFIR	15	8 5				7			69		86			38	
PP	IM	HS	GFIR	20	3-5		420-482	15 20	4-9	64-70	3-4	80-100	77	110-115	58 60		45-60	1-1 1
PP	IM	HS	GFIR	30	2-12 5		440-482		2-5	77	3	72 130	85	102 175	85		54-96	1 4
PP	IM	HS	GFIR	40			440		3-4		3	105 135	98	125-190	110		95-100	1 9
PP	IM	HS	GFL	30					3 5-4 5		3 5						100	
PP	IM	HS	GFL	40			440		3 4			180		270			120	
PP	IM	HS	GFL	50			440		3-4			190		300			150	
PP	IM	HS	MCF	10	5						47	44					25	0 7
PP	IM	HS	MCF	13	8												18	
PP	IM	HS	MCF	15	7							45					23	1
PP	IM	HS	MNF		6-14		410-440		2 5			24-125		102 165			16-67	
PP	IM	HS	MNF	25	7				7 10		25	31 35					31-32	1 8
PP	IM	HS	TF	10			482										29	
PP	IM	HS	TF	13	14							49					32 54	0 6
PP	IM	HS	TF	20	5-16		482		11-16			45-55					45-70	0 8
PP	IM	HS	TF	30			482										10-62	0 9
PP	IM	HS	TF	40	10-14		482	0 7-1 2	7		10	44-48					35	
PP	IM	IM			0 6-12		400 482	0 6-1 5	2 25	34	6 740	24 46						
PP	IM	IM	GFIR	15			510		5	71	5 6							

Izod impact (D256)				Coefficient of linear thermal expansion, flow (in/in-F) (D696)	Rockwell hardness (D785)	Durometer hardness (scale 1) (D2240)	Specific gravity (sp gr 23/23C) (D792)	Water absorption @ 24 hrs (D570)	Water absorption @ equil (D570)	Dielectric strength (V/mil) (D149)	Supplier
73°F 125in	73°F, .25in	40°F 125in	40°F, 25in								
							1 3				Ferro Corp
							0 9				RheTech
							1 1	0 01			RTP Co
							0 9				Ticona
	1						0 9	0 02			DSM Engineering Plastics
0 7				45	90-91						Huntsman Polypropylene Corp
0 6-2				34-36	83-88		0 9-1	0 02-0 03			Ferro Corp Multibase Inc RheTech, RTP Co , The Plastics Group
							1				Ferro Corp
2 8				28	75		1				Color & Composite Technologies Inc
				33-35	85 102		1-1 3	0 03			A Schulman Inc , Ferro Corp , Muehlstein Compounded Products Multibase, Inc RheTech RTP Co , The Plastics Group
							1				Ferro Corp
							1 1	0 03			RheTech
							1 1				Multibase Inc
0 3-0 4				27	87 95		1 1 1 2	0 03			Ferro Corp Multibase Inc RheTech RTP Co The Plastics Group
							1 2				Ferro Corp
0 5							1 2				M A Hanna Engineered Materials
				23-32	87-102		1 2-1 3	0 03			Ferro Corp M A Hanna Engineered Materials Multibase Inc RheTech RTP Co The Plastics Group, TP Composites Inc
							1 2				Ferro Corp
							1 1-1 5				Equistar Chemicals LP
							1				RheTech
							1	0 03			RheTech
				36			1-1 1				RheTech
							1 1				RheTech
							1 1				RheTech
				30			1 2-1 3	0 03			RheTech
							1				RheTech
2 3				44-83	75-107		0 9	0 01-0 05			Chisso America Inc Color & Composite Technologies Inc PCD Polymere GmbH RTP Co
				36-37			0 9-1	0 01			LNP Engineering Plastics Inc M A Hanna Engineered Materials
4							1 1	0 01			DSM Engineering Plastics
0 7							1 1	0 01			DSM Engineering Plastics
							1 2	0 02			RTP Co
				24			1 1	0 01			LNP Engineering Plastics Inc
							1	0 01			M A Hanna Engineered Materials
				25			1 1	0 01			LNP Engineering Plastics Inc
							1 2	0 02			RTP Co
							1 2	0 001			M A Hanna Engineered Materials
				42			0 9-1	0 01			LNP Engineering Plastics Inc PCD Polymere GmbH Washington Penn Plastic Co Inc
											PCD Polymere GmbH
											PCD Polymere GmbH
1-1 5					100		1				Michael Day Enterprises
				30	84		1	0 03			Thermofil Inc
1-1 1				24-26	49-111		1-1 1	0 01-0 04	0 02		LNP Engineering Plastics Inc M A Hanna Engineered Materials Michael Day Enterprises PCD Polymere GmbH Thermofil Inc Washington Penn Plastic Co Inc
1-4				20-24	57-117		1 1-1 4	0 02 0 03	0 06		LNP Engineering Plastics Inc Michael Day Enterprises, PCD Polymere GmbH Thermofil Inc
1 9				17	59 111		1 2	0 06	0 1		LNP Engineering Plastics Inc Michael Day Enterprises
							1 1		0 04		LNP Engineering Plastics Inc
							1 2	0 06			LNP Engineering Plastics Inc
							1 3	0 06			LNP Engineering Plastics Inc
0 7							1				Washington Penn Plastic Co Inc
							1				Washington Penn Plastic Co Inc
1							1				Washington Penn Plastic Co Inc
					52 117		0 9 1 2	0 03			Equistar Chemicals LP Thermofil Inc
1 8							1 1				Washington Penn Plastic Co Inc
											PCD Polymere GmbH
							1				Washington Penn Plastic Co Inc
0 6					98		1				Color & Composite Technologies Inc PCD Polymere GmbH Washington Penn Plastic Co Inc
											PCD Polymere GmbH
0 8					90		1 2	0 03			Color & Composite Technologies Inc PCD Polymere GmbH RheTech
0 9 2 7				17-42	50-90		0 9 1 1	0 03	0 3		ComAlloy International Corp Huntsman Polypropylene Corp M A Hanna Engineered Materials PCD Polymere GmbH PolyPacific Australia Pty Ltd Targor
					90		1		0 3		ComAlloy International Corp

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (linear-flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Compres modulus (10^4 psi) (D695)	Flexural modulus (10^4 psi) (D790)
PP	IM	IM	GFIR	20					5	68	6						46
PP	IM	IM	GFIR	25			510		4	71	5 1						48
PP	IM	IM	GFIR	30	8		482		2 4	77	4	125		165			66-67
PP	IM	IM	GFIR	40			510	12-16	2-3	114	3 5						90-116
PP	IM	IM	GMN	30			510		5	82	4						59
PP	IM	IM	MCF	25	6 5 8				8								33
PP	IM	IM	MNF		8 14				2 15		50 200	125		165			23-67
PP	IM	IM	MNF	20			510		11-15	28 36	4 289						17 28
PP	IM	IM	MNF	25			510		11	38	35						27
PP	IM	IM	MNF	40			510		9	20	174						25
PP	IM	IM	TF	13	14							49					29
PP	IM	IM	TF	20			482										
PP	IM	IM	TF	30			482										
PP	IM	IR			1 12		390-460		1 18	34-45	2 5-390	25 90		40-41	29-55		16-75
PP	IM	IR	GFIR	10				10 20	4 6						60		55
PP	IM	IR	GFIR	15			510		2	88	3						90
PP	IM	IR	GFIR	20			460-500		2 5		2	54					69 75
PP	IM	IR	GFIR	25			510		4	98	3						107
PP	IM	IR	GFIR	30	3				2			130		175			96
PP	IM	IR	MNF	15			510		10 15	39-43	10 15						29-39
PP	IM	IR	TF	20			400 450		10	38							50
PP	IM	IR	UN	44	7				10								35
PP	IM	L	GFIR	10					6-7	62	3	87					39 50
PP	IM	L	GFIR	20					6	64	3						53
PP	IM	L	GFIR	30					3-4	77	3			110			76
PP	IM	L	GFIR	40					3-4		3	135		190			85
PP	IM	LPTFE					440	15-20	19			40 45					17 18
PP	IM	LPTFE	GFIR	20			440	15-20	4-6			80					55
PP	IM	LPTFE	GFIR	30			400 460	15-20	3 5	75-97	2 5 3 5			110	60		60 75
PP	IM	LPTFE	TF	20			410 450		15 20	25	9				28		28
PP	IM	LS	GFIR	30			440	15 20	5	95	2 5						75
PP	IM	LS	TF	20			410 450		15 20	25	9				28		28
PP	IM	SU					482										
PP	IM	UVS			2 60		400-482	0 6-1 5	14-20		20 500	26-48					13-23
PP	IM	UVS	CCF	25	18				10		15	48					58
PP	IM	UVS	GFIR	10			400 440		6 7	45	3				35		35
PP	IM	UVS	GFIR	20	3				4			90		115			45
PP	IM	UVS	GFIR	30	8		482		2			125		165			67
PP	IM	UVS	MNF		8				2			125		165			67
PP	IM	UVS	TF	10	22-35				12		10-45	44-45					32 36
PP	IM	UVS	TF	12	24				12		20	46					32
PP	IM	UVS	TF	20	12 20		482		11		30	41-44					36
PP	IM	UVS	TF	25	18				10		10	51					61
PP	IM	UVS	TF	3	35				15		15	49					36
PP	IM	UVS	TF	30			482										
PP	SFM											1	0				
PP	T				0 6 29		482		2 15		3-1000	49-54			1 21		2 78
PP	T		CCF		28		400-450		13 15		90	22 35		28-50	20 42		18-35
PP	T		CCF	40	2						170	33					36
PP	T		GFIR		2-11				1-12		3 24						25-137
PP	T		GMN		9 17				1 8		7 9						61 90
PP	T		MCF				400-450		8 10			40-54		55-81	61-70		55-75
PP	T		MNF		1 20				6 13		3 5 500	31					15-67
PP	T		MNF	26	3				6-10		11	41		60			37
PP	T		TF				400-450					25 41		34			25-47
PP	T		TF	21	0 7				12-15		50	39		58			25
PP	T		UN	30	1 2				10		36	44		64			27
PP	T	HS					482										
PP	T	IM			4				2 8		6						82
PP	TP				2-2 5						150-200	42 51					14 21
PP	V				1 8						200	44					15
PP	V	IM			0 5						200	44					16
PP Alloy	EX	HS	MNF	20			482										
PP Alloy	EXC				30						740	140			3		

Compres modulus (10^4 psi) (D695)	...ural ...dulus ...^{4} psi) ...(290)	Izod impact (D256) 73°F 125in	Izod impact (D256) 73°F, .25in	Izod impact (D256) 40°F 125in	Izod impact (D256) 40°F, 25in	Coefficient of linear thermal expansion, flow (in/in-F) (D696)	Rockwell hardness (D785)	Durometer hardness (scale 1) (D2240)	Specific gravity (sp gr 23/23C) (D792)	Water absorption @ 24 hrs (D570)	Water absorption @ equil (D570)	Dielectric strength (V/mil) (D149)	Supplier
									1				Nytex Composites Co Ltd (USA)
							97		1 1		0 3		ComAlloy International Corp
	67						117		1 1	0 03			Nytex Composites Co Ltd (USA) PCD Polymere GmbH Thermofil Inc
	116					14	102-116		1 2	0 03	0 3		ComAlloy International Corp Thermofil Inc
							103		1 1		0 3		ComAlloy International Corp
						53			1 1				RheTech
	3-67						90-117		1-1 1	0 03			Thermofil Inc Tong Yang Nylon Co Ltd
	7-28						90		1		0 3		ComAlloy International Corp
							90		1 1		0 3		ComAlloy International Corp
							90		1 2		0 3		ComAlloy International Corp
									1				Washington Penn Plastic Co Inc
													PCD Polymere GmbH
													PCD Polymere GmbH
	6-75					35	90 110		0 1-1 4	0 03-0 1	0 3		Albis Canada Inc ComAlloy International Corp LNP Engineering Plastics Inc M A Hanna Engineered Materials Tong Yang Nylon Co Ltd Washington Penn Plastic Co Inc
									1 4	0 02			RTP Co
							107		1 3		0 3		ComAlloy International Corp
	75					23	95-108		1 5	0 03			Nytex Composites Co Ltd (USA) TP Composites Inc
							106		1 5		0 3		ComAlloy International Corp
						24	95		1 4	0 02			Thermofil Inc
	9						95 98		1 1-1 4		0 3		ComAlloy International Corp
		0 3							1 5				DSM Engineering Plastics
									1 4	0 05			RheTech
	50	1-1 5					100		1				Michael Day Enterprises
		1 1							1				Michael Day Enterprises
		1 4							1 1				Michael Day Enterprises
		1 9					111		1 2				Michael Day Enterprises
	18					42			1	0 01			LNP Engineering Plastics Inc
						26			1 1	0 04			LNP Engineering Plastics Inc
	75								1 2 1 3	0 01 0 06			LNP Engineering Plastics Inc M A Hanna Engineered Materials
						24			1 1	0 01			M A Hanna Engineered Materials
									1 2	0 02			LNP Engineering Plastics Inc
						24			1 1	0 01			M A Hanna Engineered Materials
													PCD Polymere GmbH
	23	1 3-2 3				44-83	65-104		0 9	0 01 0 03			Chisso America Inc Color & Composite Technologies Inc , Huntsman Polypropylene Corp PCD Polymere GmbH RheTech
		0 6				25	100		1 1				Color & Composite Technologies Inc
									1				M A Hanna Engineered Materials
						24	94		1	0 03			Thermofil, Inc
							117		1 1	0 03			PCD Polymere GmbH Thermofil Inc
							117		1 1	0 03			Thermofil Inc
	3b	0 8-1 1				28	88 95		1				Color & Composite Technologies Inc
		0 9					95		1				Color & Composite Technologies Inc
		0 9-1 5				28	86-90		1				Color & Composite Technologies Inc PCD Polymere GmbH
		0 6				25	96		1 1				Color & Composite Technologies Inc
						31	105		0 9				Color & Composite Technologies Inc
													PCD Polymere GmbH
									0				NOVA Chemicals
	8					17-61	84-102	85-89	0 9 2 1				Epsilon Products Co Huntsman Polymers Corp PCD Polymere GmbH Plastic Selection Group Inc. PolyPacific Australia Pty Ltd Solvay Polymers Inc
	5-35		1			44	82 88		1 1 1 3	0 01 0 05			DSM Engineering Plastics PolyPacific Australia Pty Ltd
									1 2				Washington Penn Plastic Co Inc
	5-137					17-33			0 9-1 3				PolyPacific Australia Pty Ltd
	51-90					17-22			1 1 1 2				PolyPacific Australia Pty Ltd
	55-75		0 6-1						1 2 1 3	0 03			DSM Engineering Plastics
	15-67					33 50	88-106		0 9 1 3				Equistar Chemicals LP PolyPacific Australia Pty Ltd
	67												Ferro Corp
	5-47		0 6-4 2						1 2	0 06			DSM Engineering Plastics
									1				Ferro Corp
									1 1				Ferro Corp
													PCD Polymere GmbH
	63					17			1 1				PolyPacific Australia Pty Ltd
	14-21						75 102		0 9				Chisso America Inc
	15						80		0 9				Chisso America Inc
	16						85		0 9				Chisso America Inc
													Targor
								99					Huntsman Polymers Corp

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (linear-flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Compres modulus (10^4 psi) (D695)	Flexural modulus (10^4 psi) (D790)	73°F 125
PP Alloy	EXS				1 7						495				1			
PP Alloy	FB				1 2						560	17			5			
PP Alloy	FC				8						570				1			
PP Alloy	IM				11-28		425 500		8-11		75 500	27-38		34 47			13-17	
PP Alloy	IM		CCF	40			450				60	37					37	
PP Alloy	IM		GFIR	30	10		425-500		1-3		2 5	160-166		208-240			82 105	
PP Alloy	IM		GFIR	50	10		425-500		1-3		2	170		260			180	
PP Alloy	IM	HS	MNF	20			482											
PP Alloy	IM	IM	GFIR	20					2-4			87		96			65	
PP Alloy	IM	IM	GFIR	30					2-3			91		107			60	
PP Alloy	IM	IR							10-15			47					23	
PP Alloy	T		MNF	41	0 5				8-11		10	35		58			35	
PP Copolymer	BM				0 3-30		428-536		10 25	27-340	100 1000	12-48			0-17		10-23	0 8-1
PP Copolymer	BM		CCF	20	0 5				14 15		200	34 36					16 22	
PP Copolymer	BM		CCF	30					12								22	
PP Copolymer	BM		CCF	40	0 4-0 5				10-12	36	200	29-38					18-30	
PP Copolymer	BM		CFR	10					2-3			40		55	80		50	
PP Copolymer	BM		MNF	20	0 5				13			34					20	
PP Copolymer	BM		TF	20	0 5				12 14		100	38-42					23-26	
PP Copolymer	BM		TF	40	0 5				9			36					38	
PP Copolymer	BM	ABU			1 2							8					2	
PP Copolymer	BM	AS			1 5-65		375-525		10 25	27	500-700	36 45			10-18		12-23	1 2 5
PP Copolymer	BM	HS			0 7-65		375 525		15-25			31-42					11 23	1 2 5
PP Copolymer	BM	IM					482											
PP Copolymer	BM	IR			1				13		150	34					18	
PP Copolymer	BM	L			1 5-2		440		10 25			40-42			14-16		12 15	
PP Copolymer	BM	MR			2												15	
PP Copolymer	BM	NA			0 7-65		375-525		10-25	27	550	31-44			10-18		13-23	1-2 5
PP Copolymer	BM	UVS			1 2							8					2	
PP Copolymer	BM	UVS	CCF	40	0 4		470			24	400	37					23	
PP Copolymer	CAL				1 7-21						1000	12-15			0-2			
PP Copolymer	CAL	ABU			1 2							8					2	
PP Copolymer	CAL	UVS			1 2							8					2	
PP Copolymer	CEX				2 7					27-50	490-500	28-43			8		8-14	
PP Copolymer	CEX	AS			2							43					17	
PP Copolymer	CM				0 4-15		400-440		12-25			28 38			14		10-11	
PP Copolymer	CM	AS			1 8 2							44-45					17 20	
PP Copolymer	CM	IM			0 5				10-25		500	38					20	
PP Copolymer	COT				2 5-7				12-25			29 33					9-10	1 6-1
PP Copolymer	EBM				1 7-21						1000	12-48			0-13		13-20	
PP Copolymer	EBM	AS			1 8-12		390-500			50	450	36-50			13-15		12-22	1
PP Copolymer	EBM	NA			1 5		440		10-25			41			16		13	
PP Copolymer	EX				0 4-18	320 330	320 525		12 25	25-50	80 700	29 60			7 16		10-31	0 6-1
PP Copolymer	EX		CCF	20	0 5				14 15		200	34 36					16-22	
PP Copolymer	EX		CCF	30	2				12								22-34	
PP Copolymer	EX		CCF	31	2												34	
PP Copolymer	EX		CCF	40	0 4 0 5				10 12	36	200	29 38					18-30	
PP Copolymer	EX		CCF	50	2 3												34	
PP Copolymer	EX		CFR	10					2 3			40		55	80		50	
PP Copolymer	EX		GFIR	20					4		3						50	

Compres modulus (10^4 psi) (D695)	ural dulus psi) 0)	Izod impact (D256) 73°F 125in	73°F, .25in	40°F 125in	40°F, 25in	Coefficient of linear thermal expansion, flow (in/in-F) (D696)	Rockwell hardness (D785)	Durometer hardness (scale 1) (D2240)	Specific gravity (sp gr 23/23C) (D792)	Water absorption @ 24 hrs (D570)	Water absorption @ equil (D570)	Dielectric strength (V/mil) (D149)	Supplier
								94					Huntsman Polymers Corp
								99					Huntsman Polymers Corp
								95					Huntsman Polymers Corp
	7					40-48	50-80		0 9	0 2			Montell U SA Inc
							90		1 2				Montell U SA Inc
	05					14	101 112		1 2	0 2			Montell U SA Inc , Nytex Composites Co Ltd (USA)
						9	115		1 4	0 2			Montell U SA Inc
													Targor
									1 1				Nytex Composites Co Ltd (USA)
									1 2				Nytex Composites Co Ltd (USA)
									0 9				Nytex Composites Co Ltd (USA)
									1 3				Ferro Corp
	23	0 8-1 3				33-83	70-101	86-92	0 9	0 01-0 03	0 2		Amoco Polymers Aristech Chemical Corp Equistar Chemicals LP Exxon Chemical Co , Fina Oil & Chemical Co , Formosa Plastics Corp USA Huntsman Polymers Corp Huntsman Polypropylene Corp , Montell U SA Inc Prime Source Polymers, Inc Solvay Polymers Inc Targor Ticona Union Carbide Corp Polymers Group
	22						92		1				Montell U SA Inc Polycom Huntsman Inc
							80		1 1				Prime Source Polymers Inc
	30						80-87		1 2-1 3				Montell U SA Inc Polycom Huntsman Inc Prime Source Polymers Inc
									0 9	0 01			RTP Co
							93		1				Montell U SA Inc
	6						91		1				Montell U SA Inc Polycom Huntsman Inc
							90		1 2				Montell U SA Inc
									0 9				Montell U SA Inc
	33	1-2 5					80-107		0 9	0 01			Amoco Polymers Equistar Chemicals LP Fina Oil & Chemical Co Huntsman Polymers Corp , Montell U SA Inc Network Polymers, Inc Phillips Sumika Polypropylene Co Solvay Polymers Inc Union Carbide Corp Polymers Group
	23	1-2 5					75-107		0 9				Equistar Chemicals LP Phillips Sumika Polypropylene Co Ticona GmbH
													Targor Ticona GmbH
	7						78		1				Montell U SA Inc
	12-15						80		0 9				Equistar Chemicals LP, Fina Oil & Chemical Co
	15						80		0 9				Equistar Chemicals LP
	13-23	1-2 5					85 107		0 9	0 03	0 2		Equistar Chemicals LP Fina Oil & Chemical Co Montell U SA Inc Phillips Sumika Polypropylene Co Solvay Polymers, Inc
	2								0 9				Montell U SA Inc
	23						82		1 2				Montell U SA Inc
	35							86-92					Huntsman Polymers Corp
	2								0 9				Montell U SA Inc
	3								0 9				Montell U SA Inc
	9-14						60-69		0 9	0 03	0 2		Montell U SA Inc Solvay Polymers Inc Union Carbide Corp Polymers Group
	17						89		0 9				Montell U SA Inc
	30-11					33-83	55-58		0 9	0 03			Huntsman Polypropylene Corp Ticona Ticona GmbH
	17-20												Phillips Sumika Polypropylene Co
	30						75						Amoco Polymers
	9-10	1 6-1 9				33	65-67			0 03			Huntsman Polypropylene Corp
	13-20						60-89	86-92	0 9	0 03	0 2		Exxon Chemical Co Huntsman Polymers Corp Montell U SA Inc Union Carbide Corp Polymers Group
	12-22	1					80-100		0 9				Amoco Polymers Montell U SA Inc Phillips Sumika Polypropylene Co. Solvay Polymers Inc , Union Carbide Corp Polymers Group
	13												Fina Oil & Chemical Co
	10-31	0 6-13				33-83	55-107		0 9 1	0 03	0 2		A Schulman Inc , Amoco Polymers Aristech Chemical Corp Dow Plastics Epsilon Products Co Equistar Chemicals LP, Fina Oil & Chemical Co , Formosa Plastics Corp USA General Polymers Huntsman Polymers Corp Huntsman Polypropylene Corp Montell U SA Inc Prime Source Polymers Inc Shuman Plastics Inc Solvay Polymers Inc Spartech Compounding Ticona Ticona GmbH Union Carbide Corp Polymers Group
	16-22						92		1				Montell U SA Inc Polycom Huntsman Inc
	22-34						80		1 1				Muehlstein Compounded Products Prime Source Polymers Inc
	34								1 1				Muehlstein Compounded Products
	18-30						80-87		1 2 1 3				Montell U SA Inc Polycom Huntsman Inc Prime Source Polymers Inc
	34								1 3				Muehlstein Compounded Products
	50								0 9	0 01			RTP Co
	50						90		1				Prime Source Polymers Inc

Type	Process	Additive	Filler/reinf	Filler %	Melt flow (g/10 min) (D1238)	Melt temp (°F)	Process temp (°F)	Injection pressure (10^3 psi)	Mold shrinkage (flow) (mil/in) (D955)	Tensile strength at break (10^2 psi) (D638)	Tensile elongation at break (%) (D638)	Tensile strength at yield (psi) (D638)	Compres strength (psi) (D695)	Flexural strength at yield (psi) (D790)	Tensile modulus (10^4 psi) (D638)	Compr modulus (10^4 psi) (D695)	Flexural modulus (10^4 psi) (D790)	73°F
PP Copolymer	EX		GFIR	30					3		3						55	
PP Copolymer	EX		MNF	20	0 5				13			34					20	
PP Copolymer	EX		TF	20	0 5				12 14		100	38-42					23-26	
PP Copolymer	EX		TF	40	0 5				9			36					38	
PP Copolymer	EX	ABU			1 2	473						8					2	
PP Copolymer	EX	AS			1 7-65		375-525			27 50	450-550	36-50			10-16		12 23	1 2 5
PP Copolymer	EX	HS			0 7-65		375 525		12 25			31-42					11-23	1 2 5
PP Copolymer	EX	HS	TF	20	1 7						130	42					29	1
PP Copolymer	EX	IM			0 5-1 5		482		10 25		500	38-41					16-21	2 5 4
PP Copolymer	EX	IR			1				12-15		150	34	35		21 23		18 19	
PP Copolymer	EX	NA			1 4-65		375 525			27	550	31 42			10		13-23	1-2 5
PP Copolymer	EX	SM				473												
PP Copolymer	EX	SU				473												
PP Copolymer	EX	UVS			0 5 1 5		470		14		600	8 41					2-18	
PP Copolymer	EX	UVS	CCF	40	0 4		470			24	400	37					23	
PP Copolymer	EXB				1 4							32					14	
PP Copolymer	EXB		MNF		1 5-18				9 11		11-40						39-49	
PP Copolymer	EXB		TF		1 5-7				8 14		40-300						29-41	
PP Copolymer	EXB	HS			0 8-36				12-20		124-510						12 20	
PP Copolymer	EXB	IR			2 5-5				15-19		150 300						15-17	
PP Copolymer	EXB	IR	MNF		50				13-15		46						20	
PP Copolymer	EXB	UVS			0 8 36				12 20		124-510						12 20	
PP Copolymer	EXC				2 7-16							32-48					15-24	
PP Copolymer	EXF				2 10	464-500	420-500		12-25	25-44	490	33 49					10-16	
PP Copolymer	EXF	ABU				473												
PP Copolymer	EXF	AS			2	473						41-42					14-15	
PP Copolymer	EXF	HS			0 7 0 9							32					11 18	
PP Copolymer	EXF	IM																
PP Copolymer	EXF	L			2							42					15	
PP Copolymer	EXF	MR			2												15	
PP Copolymer	EXF	NA			0 7 3							34-35					18-21	
PP Copolymer	EXF	SM				473												
PP Copolymer	EXF	SU			8	473			10-25		500	37					13	0 9
PP Copolymer	EXO				3							45					19	
PP Copolymer	EXP				1 7 21		430-550		12-25		440-1000	12-42			0-2		12 17	1 3
PP Copolymer	EXP		MNF		1 5 18				9-11		11-40						39-49	
PP Copolymer	EXP		TF		1 5-7				8-14		40-300						29-41	
PP Copolymer	EXP	HS			0 7 36				12-20		124-510	32					11 20	
PP Copolymer	EXP	IM					482											
PP Copolymer	EXP	IR			2 5-5				15-19		150 300						15-17	
PP Copolymer	EXP	IR	MNF		50				13-15		46						20	
PP Copolymer	EXP	NA			1 9				12-25			49					17	1 2
PP Copolymer	EXP	UVS			0 8-36				12-20		124 510						12 20	
PP Copolymer	EXS				0 3-21		420 525				80 1000	12-60			0-15		11-31	0 6-1
PP Copolymer	EXS		CCF	30	2												34	
PP Copolymer	EXS	AS			2-4				12 25			40 43					14-17	1 5
PP Copolymer	EXS	HS			0 7-2		430 470		15-25			32 33					11 18	
PP Copolymer	EXS	IM			1 1-2 5				10 25		500	38 41					16-21	2 5 4
PP Copolymer	EXS	IR			12				13 18		300	36					18	1
PP Copolymer	EXS	L			2							42					15	
PP Copolymer	EXS	NA			0 7-4				12 25			34 40					17 19	1 5
PP Copolymer	FB				1 5-7		400 440		12 25	41	500-540	29 50			1		9-22	0 7 1
PP Copolymer	FB	ABH			1 9				12 25			42					16	1 1
PP Copolymer	FB	ABM			8													
PP Copolymer	FB	IM			1 5				12 25			40					16	2 5
PP Copolymer	FB	SH			1 9				12-25			42					16	1 1
PP Copolymer	FB	SM			8												15	
PP Copolymer	FBE	AS			1 9							39						