EXHIBIT L

Strain hardening of various polyolefins in uniaxial elongational flow

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Synopsis

In this contribution correlations between the type of strain hardening of long-chain branched polyethylenes and the level of their zero shear-rate viscosities in comparison to linear polyethylenes are described. For polyethylenes of various branching structures four different types of strain hardening can be observed. Type I: strain hardening is approximately independent of elongational rate. Type II: strain hardening decreases with increasing elongational rate. Type III: strain hardening increases with increasing elongational rate. In addition to that, materials are found which do not show strain hardening within the experimental window (type IV). Qualitative correlations with the dependence of the zero shear-rate viscosity on the weight average molecular mass can heuristically be deduced. Polyethylenes of type IV fulfill the well-established relationship $\eta_0 \sim M_w^{3.4}$, samples of types I and II give higher zero shear-rate viscosities than the linear products. Type III samples generally exhibit zero shear-rate viscosities lower than the linear relationship. As the dependence of the zero shear-rate viscosities on the molecular mass offers some insight into the branching structure of a polyethylene the differences in strain hardening can heuristically be related to the molecular structure. These correlations can be transferred to different types of long-chain branched polypropylenes giving some hint to their molecular structure. © *2003 The Society of Rheology.* [DOI: 10.1122/1.1567752]

I. INTRODUCTION

Elongational flow properties of polymer melts play an important role in many processing operations like film blowing, blow moulding, and thermoforming. A feature of most of the polyolefins used in these applications is the appearance of strain hardening in elongational flow. Strain hardening induces a so-called self-healing effect which supports a homogeneous deformation of the melt. Thus, polymers exhibiting strain hardening in elongational flow improve the production of films and bottles with respect to a homogeneous distribution of wall thickness.

For tailoring the flow properties of polyolefins in the desired way it is important to know correlations between the molecular structure and the appearance of strain hardening in uniaxial elongation. It has long been established for low-density polyethylene (LDPE) that the appearance of strain hardening at high deformation rates is caused by a high degree of long-chain branching. As a consequence, LDPE can easily be operated in film blowing processes at high extrusion and take-up velocities. In contrast, in the blow

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TABLE I. Characteristic data of the polyolefins.

	Comonomer	ρ (25 °C) g/cm^3	T_m, °C	M_n, kg/mol	M_w, kg/mol	M_w/M_n
HDPE	1-hexene	0.942	134	17.6	284	16
HDPE IUPAC 5A	···	0.95	137	73	216	3.0
mLLDPE	1-butene	0.900	99	55.0	114	2.1
LDPE	···	0.918	110	15.5	258	16.6
LCB–mLLDPE	1-octene	0.902	108	47.8	98	2.1
PP 2	···	0.909	162	105	1040	10
PP 3	···	0.908	166	58	439	7.5

moulding process a high elongational viscosity is advantageous at small deformation rates, because such a feature prevents the parison from sagging under gravitational forces. High-density polyethylene (HDPE) is widely used for producing bottles in blow moulding processes. Some of these polyethylenes exhibit strain hardening especially at small deformation rates. The reason for such a strain hardening behavior of HDPE used in blow moulding has not yet been understood from the molecular point of view, however.

This paper presents results with respect to the correlation of the type of strain-hardening behavior and the molecular mass dependence of the zero shear-rate viscosity. These results are able to shed light on the appearance of strain hardening in the case of some HDPE. A clue is the sensitivity of the zero shear-rate viscosity to small changes in molecular topography, i.e., long-chain branching. The interesting aspect of the correlations found for polyethylenes is that they can as well be used to explain the different types of strain-hardening behavior reported in literature for polypropylenes of different long-chain branching structure.

II. EXPERIMENT

The elongational flow experiments presented in this study were performed by means of an oil bath extensional rheometer that has been described in detail by Münstedt *et al.* (1998). The characterization of the polyethylenes with respect to molecular mass distribution and degree of long-chain branching has been obtained by size exclusion chromatography coupled with a multi-angle laser light scattering device. The instruments used are a Waters 150 C high-temperature GPC with four Shodex columns and an 18-angle laser light scattering apparatus DAWN EOS of Wyatt Technology. In order to obtain comparable results for linear and long-chain branched polyethylenes the molecular mass distributions were determined from light scattering instead of universal calibration.

The characteristic data of the polyolefins investigated are presented in Table I. In Table I the type of comonomer, if any, the density ρ at 25 °C and the melting temperature T_m are given. For the characterization of the molecular mass distribution the number average M_n and the weight average molecular mass M_w and the polydispersity index M_w/M_n are displayed.

III. RESULTS

A problem that arises if a correlation of molecular topography and strain hardening behavior is to be established goes back to the influence of the molecular mass distribution. This has been demonstrated, e.g., by Münstedt (1980) for polystyrenes of different

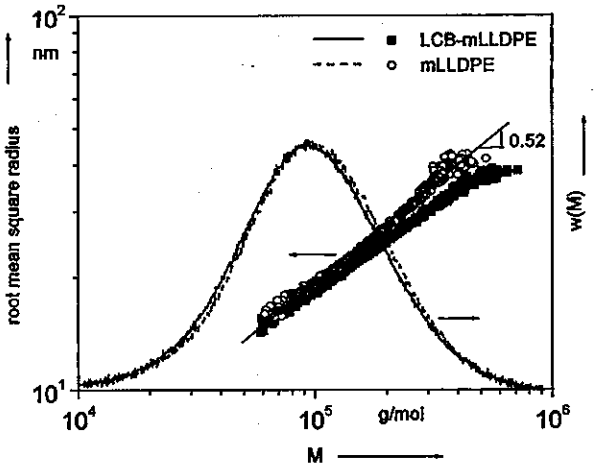


FIG. 1. Molecular mass distributions and root mean square radius of a linear and a slightly long-chain branched mLLDPE.

molecular mass distributions. In this paper it was found that distinct amounts of high molecular mass components can cause a significant strain hardening in uniaxial elongational flow at high strain rates.

Therefore, samples are of interest that possess a similar polydispersity but differ in chain topography. Such a pair of samples will be investigated in the following section.

A. Metallocene-catalyzed linear and long-chain branched LLDPE

In Fig. 1 it is demonstrated that the molecular mass distributions of the linear mLLDPE and the slightly long-chain branched LCB–mLLDPE are very similar. For the LCB–mLLDPE the weight average molecular mass is slightly smaller than for the linear mLLDPE (Table I). The molecular mass dependence of the root mean square radius clearly indicates the presence of long-chain branches in the case of LCB–mLLDPE, because long-chain branches (filled symbols in Fig. 1) cause a reduction of the root-mean-square radius in comparison to linear molecules of the same molecular mass (open symbols in Fig. 1). A considerable amount of short-chain branching also leads to a reduction of the radius of gyration compared to a linear material, especially if higher α-olefins are incorporated. As has been shown by Gabriel and Münstedt (1999) using rheological means LCB–mLLDPE definitely contains long-chain branches. But the number of long-chain branches has to be regarded as rather minute as the deviation from the line of the linear product is small. In the experimental setup used the log-log slope of the root mean square radius versus molecular mass with a value of 0.52 as indicated for mLLDPE is typical of linear polyethylenes (Fig. 1).

The time-dependent elongational viscosities of the two mLLDPE are plotted in Fig. 2. The linear mLLDPE does not exhibit any indication of strain hardening. This behavior is labeled type IV. The time-dependent elongational viscosity of mLLDPE is equal to the threefold of the time-dependent shear viscosity at all experimentally accessible times and elongational rates. In contrast, the slightly long-chain branched LCB–mLLDPE exhibits a totally different time dependence of the elongational viscosity. LCB–mLLDPE does show strain hardening at all elongational rates investigated. The amount of strain hardening does not differ, however, within the experimental window (type I). The good

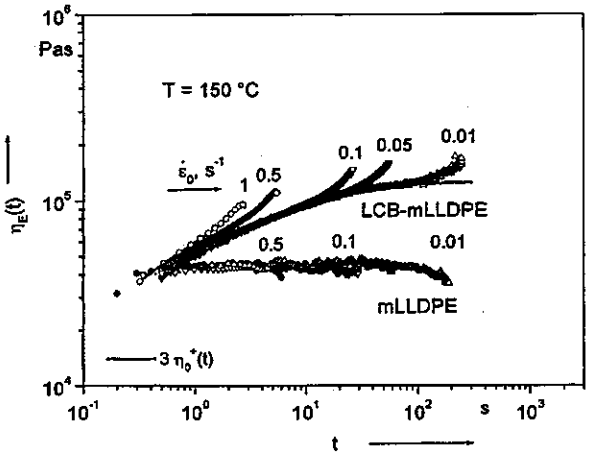


FIG. 2. Time-dependent elongational viscosities of a linear and a slightly long-chain branched mLLDPE of similar molecular mass distribution. The maximum Hencky elongation was $\epsilon = 2.9$ for all experiments.

agreement between $3\eta_0^+(t)$ and the envelope of the elongational data in the linear range gives a hint to the reliability of the measurements.

As the molecular mass distributions of the two mLLDPE are comparable the strain hardening of LCB–mLLDPE can be attributed to the presence of small amounts of long-chain branches. A similar elongational behavior was reported by Bin Wadud and Baird (2000) and by Malmberg *et al.* (2000, 2002) for slightly long-chain branched polyethylenes. Another indication of small amounts of long-chain branches is the increased level of the linear elongational viscosity $3\eta_0^+(t)$ compared to the mLLDPE although the weight average molecular mass of LCB–mLLDPE is slightly lower. As has been demonstrated by Gabriel and Münstedt (1999, 2001) small amounts of long-chain branches in polyethylenes lead to a significant increase in zero shear-rate viscosity compared to linear polyethylene of the same molecular mass. This feature of slightly long-chain branched polyethylenes is reflected by the elevated steady-state elongational viscosity in the case of LCB–mLLDPE. The results demonstrate that small amounts of long-chain branches in polyethylenes of narrow molecular mass distribution can cause significant changes in the time dependence of the start-up curve of the elongational viscosity and the appearance of strain hardening.

B. Linear high density (HDPE) and long-chain branched low density polyethylenes (LDPE)

The molecular characterization of a typical LDPE used for film blowing and an HDPE applied in blow moulding is presented in Fig. 3. Both the LDPE and the HDPE possess very broad molecular mass distributions with distinct amounts of high molecular mass components. The weight average molecular masses are similar as is shown in Table I. The molecular mass dependence of the root mean square radius indicates that the LDPE is highly long-chain branched. In contrast, for the HDPE no indication of long-chain branching is observable as the slope of the log-log-plot of the radius of gyration as a function of molecular mass is similar to that of the linear mLLDPE plotted in Fig. 1.

The time-dependent elongational viscosities of the HDPE and LDPE are plotted in Fig. 4. The LDPE shows a strain hardening behavior increasing with strain rate (type III)

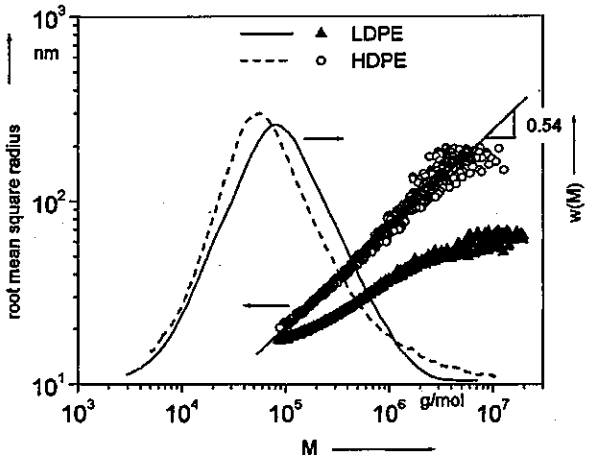


FIG. 3. Molecular mass distributions and root mean square radius of a HDPE used for blow moulding and a LDPE used in film blowing applications.

[Kurzbeck (1999)]. The strain hardening behavior of the HDPE is totally different as the elongational viscosity increases significantly with decreasing strain rate (type II) [Koch (1997)]. For both polyethylenes the linear viscoelastic flow curve in elongation corresponds well to the threefold of the time-dependent shear viscosity, i.e., the Trouton relationship is fulfilled as it should be expected for reliable measurements. Tests of the thermal stability of the HDPE are also shown in Fig. 4. They indicate that the storage modulus of the HDPE at a temperature of 170 °C does not decrease more than 5% over 5000 s. The time for the elongational experiments including sample preparation lies within this time limit even at the lowest elongational rates. Therefore, the viscosity increase is obviously not due to thermally induced molecular changes.

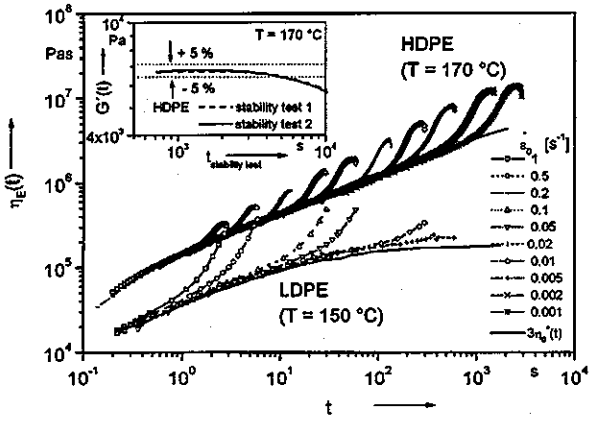


FIG. 4. Time-dependent elongational viscosities of a LDPE and a HDPE. The maximum elongation was $\epsilon = 2.9$ for all experiments. The inset shows stability tests of the HDPE at a measurement temperature of 170 °C. The tests were performed at a frequency of 0.01 Hz and a deformation amplitude of 0.03.

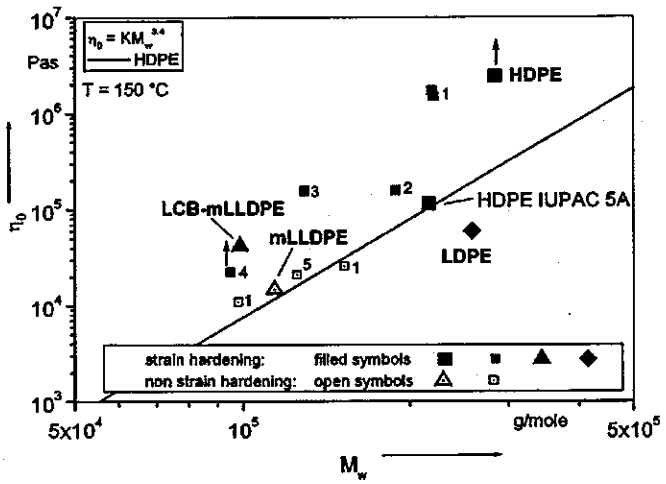


FIG. 5. Molecular mass dependence of the zero shear-rate viscosity of linear and long-chain branched polyethylenes. The open symbols indicate samples with non-strain hardening behavior, the filled symbols are for polyethylenes which exhibit a significant strain hardening in elongational flow. Small symbol sizes are chosen for literature data. The arrows indicate that the steady state of deformation in shear was not reached, i.e., the actual zero shear-rate viscosities are still higher than the measured values. The references indicated in the diagram by numbers are: (1) Münstedt and Laun (1981), (2) Langouche and Debbaut (1999) and Wagner *et al.* (2000), (3) Hachmann (1996) and Wagner *et al.* (1998), (4) Malmberg *et al.* (2000), and (5) Schweizer (2000).

C. Molecular mass dependence of the zero shear-rate viscosities

A hint to a qualitative explanation of the strain-hardening behavior of the HDPE investigated in this study can be deduced from the molecular mass dependence of their zero shear-rate viscosities and the comparison with their strain hardening (Fig. 5). For linear polyethylenes a power law dependence with an exponent of 3.4 has been established in literature [e.g. Münstedt (1986); Laun (1987)] It is plotted in Fig. 5 as a full line. It should be noted that other authors find exponents larger than 3.4. Wasserman and Graessley (1996), e.g., report an exponent of 3.6 for polydisperse polyethylenes. This small difference of the exponents, however, is not decisive for the conclusions drawn in this paper from the molecular mass dependence of the zero shear-rate viscosity. The zero shear-rate viscosity of the linear mLLDPE corresponds well with this dependence. For the slightly long-chain branched LCB–mLLDPE an increased zero-shear rate viscosity is obtained that can be explained by small amounts of long-chain branches leading to star-like and H-shaped molecular topographies [Gabriel (2001)]. An increase of the zero shear-rate viscosities of slightly long-chain branched polyethylenes in comparison to their linear counterparts has also been reported by a number of other authors [Vega *et al.* (1998); Malmberg *et al.* (1999); Janzen and Colby (1999); Wood-Adams *et al.* (2000)].

It should be mentioned that the power-law relationship between the zero shear-rate viscosity and the weight average molecular mass is not influenced by the polydispersity of the molecular mass distribution. For blends of linear polymers, e.g. polyisobutylenes and polystyrenes, it was demonstrated in literature that the zero shear-rate viscosity depends only on the weight average molecular mass but not on the composition of the blends, i.e., the polydispersity of the molecular mass distribution [Pechhold *et al.* (1981); Masuda *et al.* (1970)]. The same is valid for HDPE as follows from the fact that the different samples which fulfill the relationship $\eta_0 \sim M_w^{3,4}$ possess a variety of molecular mass distributions.

A high degree of long-chain branching in LDPE causes a reduction in zero shear-rate viscosity as is well established in literature [e.g., Münstedt (1986)]. For the LDPE investigated in this study the expected behavior is found, i.e., the zero shear-rate viscosity is significantly reduced in comparison to linear polyethylene of the same weight average molecular mass (Fig. 5).

The HDPE investigated in this paper shows a significantly increased low shear-rate viscosity when compared with classical linear polyethylenes (Fig. 5). The arrow indicates that the true zero shear-rate viscosity of this HDPE will be even higher than the value indicated in Fig. 5. Long-chain branching is not detectable, however, from the light scattering experiments within the accuracy of the measurements (Fig. 3).

The comparison of the results on the LCB–mLLDPE and the HDPE leads to the hypothesis that small amounts of long-chain branches in the HDPE, which cannot be detected analytically, give rise to a significantly increased zero shear-rate viscosity. The presence of very small amounts of long-chain branching in the HDPE is not unlikely. This HDPE is a Phillips-type product, which is in principle susceptible to forming long-chain branching in the extrusion step following polymerization, for example. Regarding the strain hardening behavior of the LCB–mLLDPE and the HDPE the rate dependence of which is different from that of LDPE one can heuristically conclude that it may be due to a small amount of long-chain branching with star-like and/or H-shaped molecular structures.

This conclusion gets remarkable support if data from literature are plotted according to Fig. 5. It compares the zero shear-rate viscosities of polyethylene melts that were reported to exhibit increasing strain hardening with decreasing strain rate (filled symbols, type II) with those that did not show any strain hardening (open symbols, type IV). The references are given in the caption to Fig. 5. The zero shear-rate viscosities of the non-strain hardening polyethylenes agree very well with the power law dependence of the zero shear-rate viscosity on molecular mass established for linear polyethylenes, especially if it is taken into account that the experimental data stem from different sources. In contrast, polyethylenes assumed to be linear but exhibiting strain hardening have got significantly elevated zero shear-rate viscosities. This becomes obvious from the HDPE investigated by Münstedt and Laun (1981), Langouche and Debbaut (1999), Wagner *et al.* (2000), and Hachmann (1996) and the LCB–mPE investigated by Malmberg *et al.* (2000) that all show a type II strain hardening behavior.

It should be noted that in principle the elongational patterns of a polymer melt depend upon the experimental window and its relation to the relaxation time spectrum of the materials. Thus, a change in temperature will alter the viscosity ratios of the different polyethylenes but it will not change the qualitative classification described. Furthermore, the observed patterns cannot unequivocally be related to the maximum relaxation times of the polyethylenes. The maximum relaxation times of LCB–mLLDPE ($\tau_{max} = 21$ s), LDPE ($\tau_{max} = 46$ s), and HDPE ($\tau_{max} > 48$ s) are of the same order of magnitude. These materials should therefore exhibit a similar time and strain rate dependence in the same experimental window, which is obviously not the case.

This very qualitative explanation needs more elaboration, of course. The rheological results should be discussed in the light of different molecular theories [e.g., McLeish and Larson (1998); Wagner *et al.* (1998)] in order to obtain a more quantitative picture.

It shall also be demonstrated that linear polyethylenes the zero shear-rate viscosity of which falls onto the expected power law dependence upon molecular mass may also show strain hardening. Similar effects may also be found for long-chain branched polyethylenes as the representation of the molecular mass dependence of zero shear-rate viscosity is not unequivocal with respect to a deduction of the molecular topography.

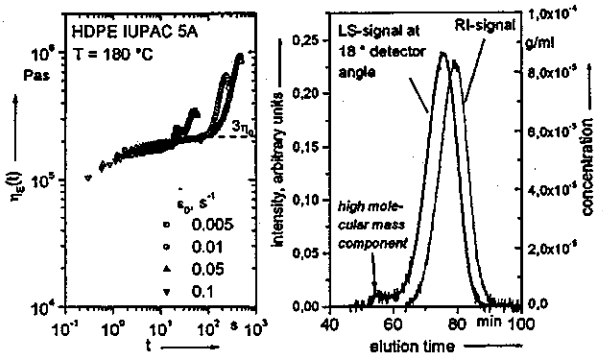


FIG. 6. Time-dependent elongational viscosities of a linear HDPE IUPAC 5A (left hand side) and elution diagrams (right-hand side).

The HDPE IUPAC 5A exhibits a considerable amount of strain hardening (Fig. 6), but the zero shear-rate viscosity falls onto the relationship established for linear polyethylenes (Fig. 5). The reason for the pronounced strain hardening can be found in a distinct high molecular mass component that is obvious from the light scattering signal at an elution time of 55 min shown on the right hand side of Fig. 6. It should be noted that similar correlations can be found for linear polystyrenes. As has been shown by Münstedt (1980) the addition of a high molecular mass component to a narrow molecular mass distribution polystyrene leads to pronounced strain hardening. As has additionally been shown, the zero elongational viscosities of polystyrene samples of different polydispersity obey the expected power law dependence upon weight average molecular mass with an exponent of 3.5. Similar results on polystyrenes were found by Hepperle (2002).

D. Polypropylene melts

Correlations similar to the ones for polyethylenes can be found for polypropylenes. They give a hint to different topographies of their long-chain branching structure. In Fig. 7 the time-dependent elongational viscosities of an electron beam irradiated polypropylene PP 2 [Kurzbeck (1999); Kurzbeck *et al.* (1999)] and of a chemically modified polypropylene PP [Hingmann and Marczinke (1994)] are compared with those of a linear polypropylene PP 3. It is obvious that the time and strain-rate dependence of the elongational viscosities of the polypropylenes is different although the viscosity levels are comparable. The linear polypropylene PP 3 does not show any indication of strain hardening (type IV). The decrease of the elongational viscosities at higher strains is due to an inhomogeneity in deformation. Whereas the irradiated PP 2 exhibits a strain-hardening behavior which is similar to that of highly long-chain branched LDPE (type III), i.e., increasing strain hardening with increasing strain rate, the strain hardening behavior of the chemically long-chain branched polypropylene PP resembles that of the HDPE discussed previously (type II).

In addition, the molecular mass dependence of the zero shear-rate viscosities of the polypropylenes is plotted in Fig. 8. It is in qualitative accordance with the observations reported for polyethylenes. The zero shear-rate viscosity of PP 3 (type IV) corresponds well with the power law dependence of the zero shear-rate viscosity on weight average molecular mass for linear polypropylenes. The zero shear-rate viscosity of the electron beam irradiated PP 2 (type III) is smaller than for the linear polypropylene of corresponding molecular mass. In analogy to polyethylenes a highly long-chain branched structure

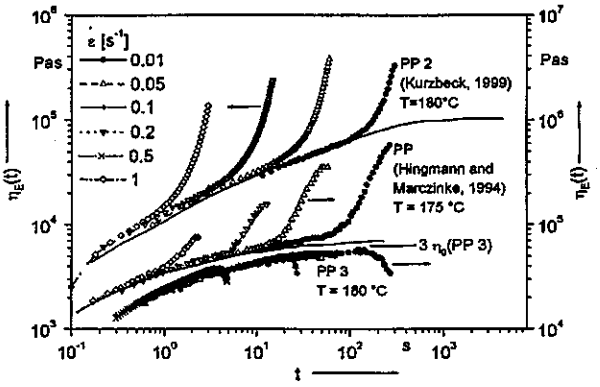


FIG. 7. Time-dependent elongational viscosities of a linear (PP 3) and two long-chain branched polypropylenes (PP and PP 2). The elongational data of PP 2 are plotted on the left axis, those of PP and PP 3 on the right axis. Left and right axis are shifted by one order of magnitude. The downturn of the elongational viscosity curve of PP 3 is caused by a nonhomogeneous deformation occurring due to the absence of strain hardening.

like in the case of LDPE has to be assumed which is not unreasonable for this kind of electron beam irradiated polypropylene. The chemically branched PP (type II) with an average of 1.5 long-chain branches per molecule [Hingmann and Marczinke (1994)] exhibits an elevated zero shear-rate viscosity as it is similarly found for slightly long-chain branched polyethylenes. This result gives rise to the assumption of the presence of star-like and/or H-shaped molecular structures in the chemically long-chain branched polypropylene.

The observations presented so far can be substantiated by some recent publications. A very similar flow behavior compared to the chemically modified PP of Hingmann and Marczinke (1994) has been found by Weng *et al.* (2001). The authors polymerized a long-chain branched polypropylene by means of a metallocene catalyst that is able to incorporate preformed, vinyl-terminated macromonomers into the growing backbone. This material exhibits an enhanced zero shear-rate viscosity and a strain hardening that

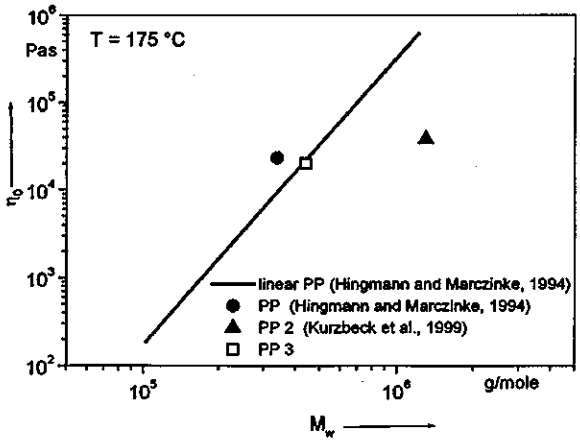


FIG. 8. Molecular mass dependence of the zero shear-rate viscosities of linear and long-chain branched polypropylenes.

increases with decreasing strain rate. Direct comparisons are difficult as in the cited paper no temperatures of the rheological experiments are given. Auhl *et al.* (2002) introduced long-chain branching into PP via electron beam irradiation. A growing irradiation dose leads to an increase in the degree of long-chain branching as has been shown by coupled SEC-MALLS experiments. The sample with the smallest irradiation dose exhibited an increased zero shear-rate viscosity compared to linear PP. The amount of strain hardening increased with decreasing strain rate. This flow behavior resembles type II. The irradiated PP samples that were subjected to higher doses showed a gradual decrease in zero shear-rate viscosity and a corresponding change in the strain hardening behavior. For the series of four irradiated PP the strain hardening behavior changed from type II of a slightly long-chain branched sample to type III thus indicating a highly branched product. These results support the conclusions drawn from the data presented in this publication.

IV. CONCLUSIONS

From the experimental results the following conclusions can be drawn with respect to the influence of varying topograpies of long-chain branches on viscoelastic properties of polyolefin melts in uniaxial elongational flow and in shear:

- Small amounts of long-chain branches in metallocene-catalyzed polyethylenes cause significant strain hardening in elongational flow. In parallel an increase of the zero shear-rate viscosity in comparison to a linear polyethylene of the same molecular mass is observed. It can be postulated that both effects have their origin in a very small degree of long-chain branching leading to star-like and/or H-shaped molecular topographies with long branches and a correspondingly high number of entanglements per branch.
- A high degree of long-chain branching typical of classical LDPE results in a pronounced strain hardening at high strain rates. The zero shear-rate viscosity is reduced in comparison to a linear polyethylene of the same molecular mass. This effect is due to a reduced molecular size of the highly long-chain branched molecules and a small number of entanglements per branch.
- For some high-density polyethylenes a strain-hardening behavior that increases with decreasing strain rate is found. These materials also exhibit an elevated zero shear-rate viscosity indicating the presence of small amounts of long-chain branches.
- The linear polypropylene investigated does not show strain hardening. Its zero shear-rate viscosity follows the relationship $\eta_0 \sim M_w^{3.4}$ as established for linear polypropylenes.
- For the two long-chain branched polypropylenes strain hardening is found. The polypropylene for which strain hardening increases with strain rate exhibits a reduced zero shear-rate viscosity, the one for which strain hardening decreases with growing strain rate shows an elevated zero shear-rate viscosity compared to linear polypropylene.
- For the polyethylenes and polypropylenes investigated and the cited literature data similar relationships between strain hardening in elongational flow and molecular mass dependence of the zero shear-rate viscosity were found.
- From the observed similarities it can be concluded that the number of entanglements per branch is a decisive parameter influencing shear and elongational behavior, especially the level of zero shear-rate viscosity and the type of strain hardening.
- Fore a more thorough understanding of the described phenomena sophisticated molecular theories have to be applied. They have to take into consideration the distribution both of molecular mass as well as length and degree of long-chain branching.

- For commercial polyolefins with unknown branching structure analytical means are required to obtain as much information on molecular structure as possible. For sparse amounts of long-chain branching, however, these methods often fail. In those cases rheological experiments can contribute to a qualitative analysis.

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Quantitative assessment of strain hardening of low-density polyethylene melts by the molecular stress function model

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Synopsis

The elongational viscosity of three tubular and five autoclave low-density polyethylene (LDPE) melts is analyzed, and quantitative comparison of the strain-hardening characteristics is made by using the molecular stress function model. This is based on a new strain-energy function, which assumes that the total strain energy of a branched section of a macromolecule is given by the addition of the strain energies of the individual chain segments contained in this section. The model employs only two nonlinear material parameters: one parameter describes the average number of crosslinked chain segments, which occupy the same tube section, and determines the slope of the elongational viscosity after inception of strain hardening. The second parameter indicates the maximum relative stretch of the chain segments and determines the steady-state (plateau) value of the elongational viscosity. Both parameters depend on the complex branching topology of LDPE melts. While quantitative relationships between branching structure and the two nonlinear parameters are not yet available, the results of this comparison seem to indicate that the more tree-like structure of autoclave LDPE leads to a higher density of crosslinked chain segments in the same tube section than in the case of LDPE polymerized in tubular reactors. © *2003 The Society of Rheology.* [DOI: 10.1122/1.1562155]

I. INTRODUCTION

It is generally accepted that the "strain-hardening" behavior of the elongational viscosity, which is usually defined as a departure from an upward turn of the elongational viscosity above the linear-viscoelastic start-up asymptote, is of prime importance for the processability of polymer melts in processes that involve free surface flow. Long-chain

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TABLE I. Molecular weight and relaxation spectra of tubular LDPEs.

(a) Sample	Tubular-a		Tubular-b		Tubular-o	
M_n	1.7×10^4		1.8×10^4		1.9×10^4	
M_w	1.1×10^5		8.7×10^4		6.9×10^4	
i	g_i (Pa)	λ_i (s)	g_i (Pa)	λ_i (s)	g_i (Pa)	λ_i (s)
1	120	1200	60	550	50	100
2	600	300	1000	130	900	20
3	5000	50	3000	30	5500	2.5
4	15 000	6	10 000	5	9000	0.5
5	30 000	0.6	30 000	0.6	30 000	0.08
6	50 000	0.08	50 000	0.08	70 000	0.01
7			40 000	0.006	80 000	0.002

Molecular weight and relaxation spectra of autoclave LDPEs.

(b) Sample	Autoclave-A		Autoclave-B		Autoclave-C		Autoclave-D		Autoclave-O	
M_n	1.4×10^4		1.8×10^4		1.7×10^4		1.8×10^4		2.2×10^4	
M_w	1.4×10^5		1.5×10^5		1.5×10^5		1.6×10^5		2.0×10^5	
i	g_i (Pa)	λ_i (s)	g_i (Pa)	λ_i (s)	g_i (Pa)	λ_i (s)	g_i (Pa)	λ_i (s)	g_i (Pa)	λ_i (s)
1	40	60	40	100	100	60	100	90	20	120
2	500	8	250	20	900	9	1000	10	300	30
3	2000	1.5	1800	4	5000	1.2	2500	1.5	2200	5
4	6000	0.3	7000	0.6	10 000	0.2	12 000	0.3	7000	0.7
5	20 000	0.05	20 000	0.08	50 000	0.01	15 000	0.05	25 000	0.09
6	80 000	0.007	50 000	0.01	300 000	0.002	80 000	0.007	70 000	0.008
7									120 000	0.001

branching in particular is known to enhance strain hardening considerably, and low-density polyethylene (LDPE) is generally known for its good processability in film blowing and film casting.

Due to the radical polymerization process, the branching structure of commercial LDPEs is not known, which makes it difficult to assess the exact relationship between the branching structure and strain hardening. There is evidence that the branching structure is related to the type of polymerization process: LDPE produced in autoclave reactors has a more tree-like structure and more long-chain branching whereas in tubular reactors a more comb-like structure results [Kuhn and Kroemer (1982); Tackx and Tacx (1998)].

In this paper, the elongational viscosity of three tubular and five autoclave LDPEs is analyzed on the basis of the molecular stress function V (MSF) model [Wagner *et al.* (2001)]. A new strain energy function for long-chain branched polymer melts based on a multichain segmental MSF model is presented, which gives additional insight into the origin of the enhanced strain hardening of long-chain branched polymer melts, and allows quantitative description of the strain-hardening behavior of all eight LDPE melts using only two nonlinear material parameters.

II. EXPERIMENT

Three tubular LDPEs and five autoclave LDPEs were employed. The number and weight average molecular weights, determined by gel permeation chromatography (GPC) (Waters, 150-C), are shown in Table I. Four autoclave LDPEs (autoclaves A, B, C, D) were investigated by Satoh *et al.* (2001), and one tubular LDPE (tubular-o) and one

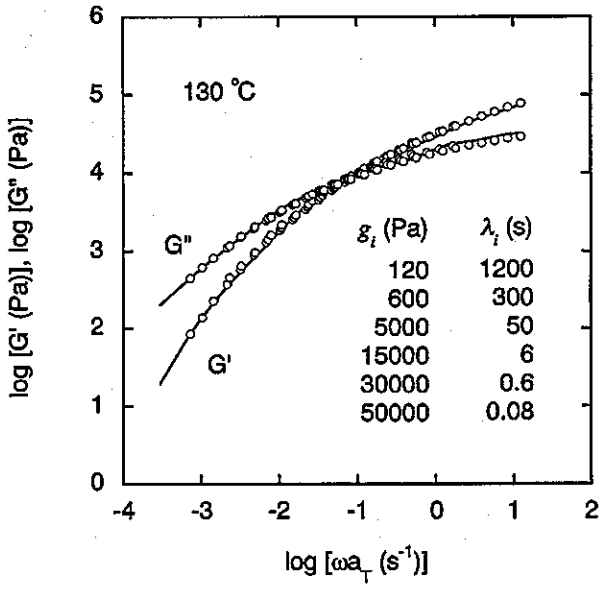


FIG. 1. Master curves of frequency dependence of oscillatory shear moduli at 130 °C for tubular-a.

autoclave LDPE (autoclave-O) were studied by Yamaguchi and Takahashi (2001). Further, experimental data of two tubular LDPEs (tubular a and b) were collected in this study as follows.

The frequency dependence of oscillatory shear moduli was measured at various temperatures to obtain the master curves for tubular a and tubular b using a cone-and-plate rheometer (Rheometrics, dynamic stress rheometer SR-2000) and are shown in Figs. 1 and 2. The master curves for the other samples were presented by Satoh *et al.* (2001) and by Yamaguchi and Takahashi (2001). The linear-viscoelastic parameters, such as moduli g_i and relaxation times λ_i, of the discrete relaxation spectra, for all samples are also summarized in Table I.

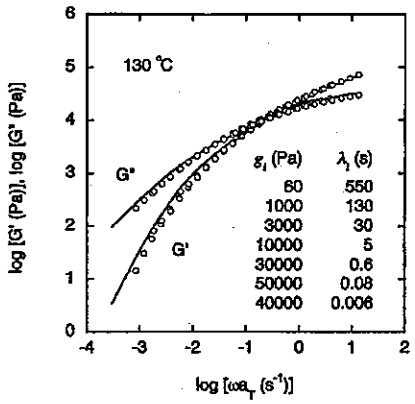


FIG. 2. Master curves of frequency dependence of oscillatory shear moduli at 130 °C for tubular-b.

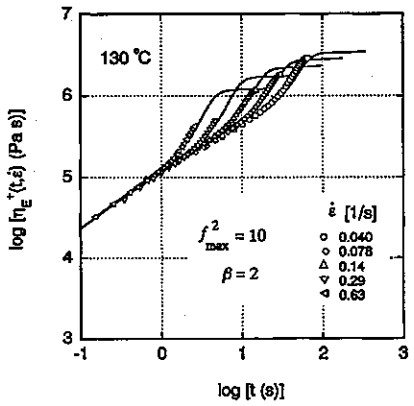


FIG. 3. Comparison of the predictions (lines) of the MSF model to experimental data (symbols) of uniaxial elongational viscosity at 130 °C for tubular-a. The parameters are set to $f^2_{max} = 10$ and $\beta = 2$.

Growth curves of uniaxial elongational viscosity were measured in a silicone oil bath using a Meissner-type rheometer (Toyoseiki, MELTEN rheometer) at various strain rates $\dot{\varepsilon}$ for tubular a and tubular b at 130 °C and are shown in Figs. 3 and 4. Rod-like samples with diameters of 3–4 mm and lengths of 150–170 mm were prepared by means of a capillary rheometer at 160 °C. The sample specimens were annealed in a silicone oil bath for 20 min prior to the experiment. The diameter of each sample was recorded during stretching by a video camera. The uniaxial elongational viscosity data for the other samples were also collected in the same way by the same elongational rheometer [Satoh *et al.* (2001); Yamaguchi and Takahashi (2001)] and are shown in Figs. 5–10.

III. MOLECULAR STRESS FUNCTION MODEL

Intermolecular interaction of concentrated systems of monodisperse linear polymer chains is modeled by the tube concept: The mesh of constraints caused by surrounding chains confines the macromolecular chain laterally to a tube-like region. Doi and Edwards (1978a), (1978b), (1979), (1986) assumed that the diameter a_0 of the tube is not changed even by large nonlinear deformation, or equivalently that the tension in the deformed macromolecular chain remains constant and equal to its equilibrium value.

Consequently, the Doi–Edwards model does not account for any strain hardening in extensional flow. However, from an analysis of stress–strain data of many polydisperse polymer melts and rubbers, it was found that the tension in the molecular chains increases and the tube diameter decreases with an increase in deformation [Wagner and Schaeffer (1992, 1993); Wagner (1994)].

By generalizing the Doi–Edwards (DE) model to molecular stress function theory, Wagner *et al.* (2001) showed that the extensional viscosities of polymer melts in uniaxial, equibiaxial and planar constant extension-rate experiments can be described quantitatively. While the strain hardening of linear polydisperse polymer melts (high-density polyethylene, polystyrene, polypropylene) can be accounted for by the tube diameter, which decreases affinely with the average stretch, long-chain branched polymer melts (low-density polyethylene, long-chain branched polypropylene) show enhanced strain hardening in extensional flows, which was quantified by a molecular stress function, the square of which is quadratic in the average stretch [Bastian (2001); Wagner *et al.* (2002)].

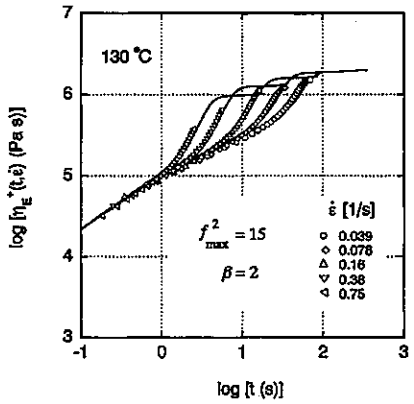


FIG. 4. Comparison of the predictions (lines) of the MSF model to experimental data (symbols) of uniaxial elongational viscosity at 130 °C for tubular-b. The parameters are set to $f^2_{max} = 15$ and $\beta = 2$.

According to the MSF model, the relative tension (relative to its equilibrium value) of the macromolecular chain in a tube segment of diameter a at time t is expressed by a molecular stress function f, which is the inverse of the relative tube diameter a/a_0,

$$f(t,t') = a_0/a(t,t'), \tag{1}$$

where t' indicates the time at which the tube segment was created with equilibrium tube diameter a_0. For Gaussian chains, tension and stretch are proportional to each other, and therefore f also represents the stretch of a tube segment. From its definition it is obvious that $f = f(t,t')$ depends on the deformation history of tube segments, i.e., it is a property of the individual tube segment, and in general the stretch will vary along the tube.

The extra stress tensor $\sigma(t)$ of the MSF model is then given by a history integral of the second order orientation tensor $\mathbf{S}(t,t')$ multiplied by the square of the molecular stress function $f(t,t')$,

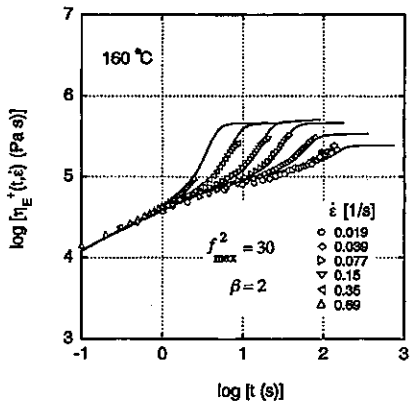


FIG. 5. Comparison of the predictions (lines) of the MSF model to experimental data (symbols) of uniaxial elongational viscosity at 160 °C for tubular-o. The parameters are set to $f^2_{max} = 30$ and $\beta = 2$.

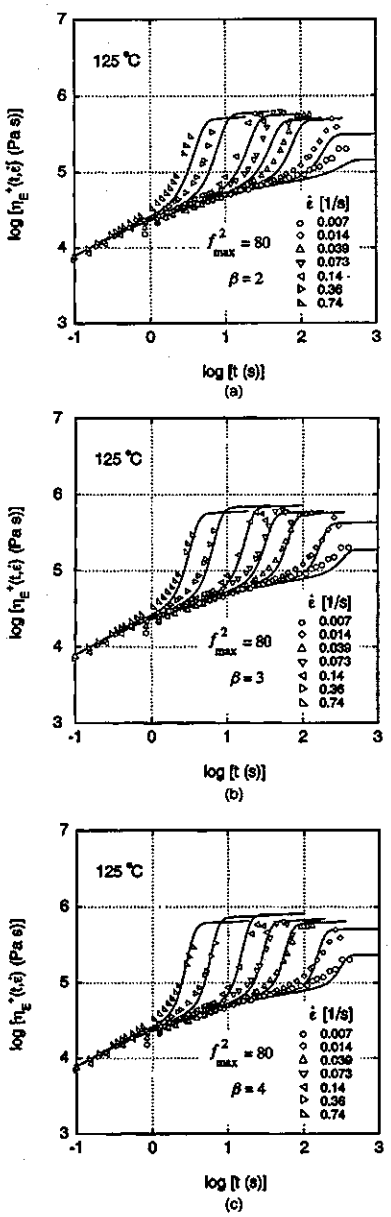


FIG. 6. Comparison of the predictions (lines) of the MSF model to experimental data (symbols) of uniaxial elongational viscosity at 160 °C for autoclave-D; $\beta =$ (a) 2, (b) 3, and (c) 4. A value of $f^2_{\max} = 80$ was chosen for the predictions.

$$\sigma(t) = 5\int_{-\infty}^{t} m(t-t')f^2\left\langle \frac{\mathbf{u}'\mathbf{u}'}{u'^2}\right\rangle_0 dt' = \int_{-\infty}^{t} m(t-t')f^2 \mathbf{S} dt', \qquad (2)$$

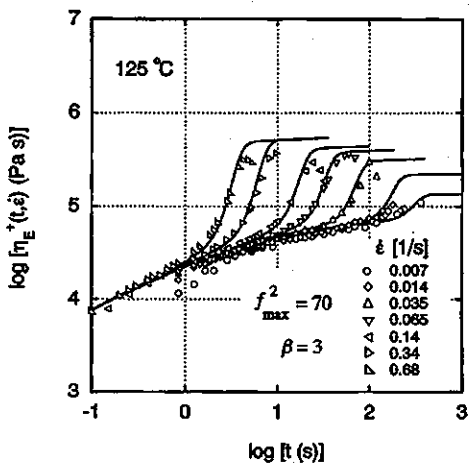


FIG. 7. Comparison of the predictions (lines) of the MSF model to experimental data (symbols) of uniaxial elongational viscosity at 160 °C for autoclave-A. The parameters are set to $f^2_{\max} = 70$ and $\beta = 3$.

with linear-viscoelastic memory function $m(t-t')$. $\mathbf{u}'\mathbf{u}'$ is the dyad of a deformed unit vector $\mathbf{u}$,

$$\mathbf{u}'(t,t') = \mathbf{F}^{-1}_{t,t'} \cdot \mathbf{u}, \tag{3}$$

where $\mathbf{F}^{-1}$ is the deformation gradient tensor and u' is the length of $\mathbf{u}'$. The orientational average is indicated by $\langle \ldots \rangle_0$,

$$\langle \ldots \rangle_0 \equiv \frac{1}{4\pi} \oint [\ldots] \sin\theta_0 d\theta_0 d\varphi_0. \tag{4}$$

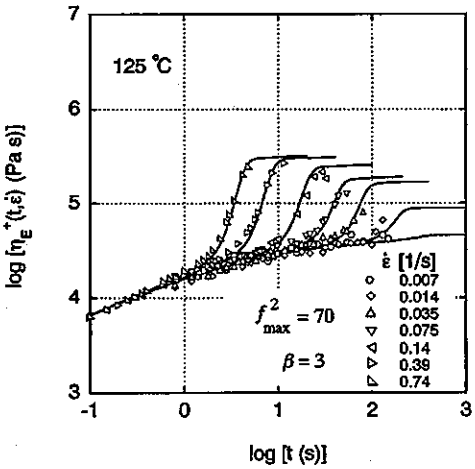


FIG. 8. Comparison of the predictions (lines) of the MSF model to experimental data (symbols) of uniaxial elongational viscosity at 160 °C for autoclave-B. The parameters are set to $f^2_{\max} = 70$ and $\beta = 3$.

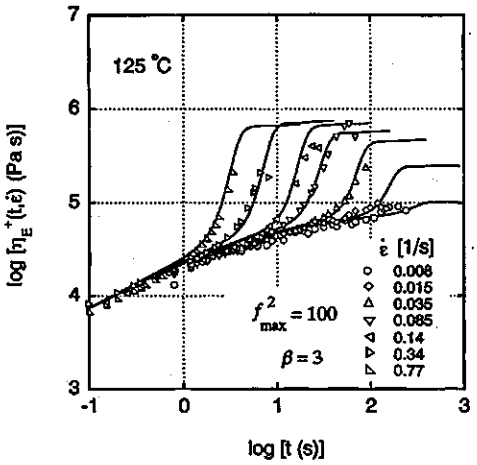


FIG. 9. Comparison of the predictions (lines) of the MSF model to experimental data (symbols) of uniaxial elongational viscosity at 160 °C for autoclave-C. The parameters are set to $f^2_{max} = 100$ and $\beta = 3$.

To simplify the notation, the dependence on t and t' is dropped. Note that while $\mathbf{S}$ is related directly to the deformation history via Eq. (3), no *a priori* dynamics of the internal variable f are prescribed in the MSF model. Rather, f^2 is assumed to be directly related to the strain energy stored in the polymeric system, and is determined by an evolution equation derived from an energy balance argument [Wagner *et al.* (2001)].

Based on prior work of de Gennes (1974) and of Marrucci and Hermans (1980), the molecular stress function f for *linear* melts is related to a strain-energy function w_{MSF} of the form

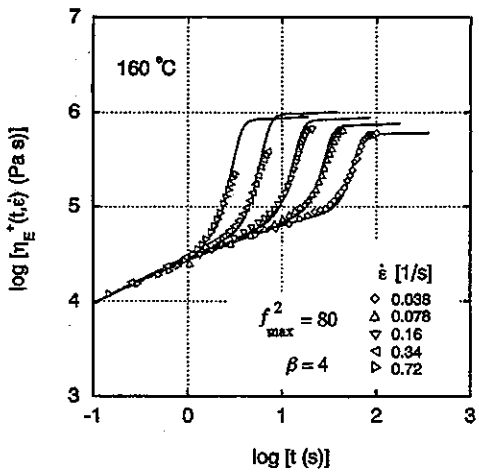


FIG. 10. Comparison of the predictions (lines) of the MSF model to experimental data (symbols) of uniaxial elongational viscosity at 160 °C for autoclave-O. The parameters are set to $f^2_{max} = 80$ and $\beta = 4$.

$$\frac{w_{\mathrm{MSF}}}{3kT} = (f^2-1). \tag{5}$$

Neglecting dissipative constraint release, the power of the stress tensor input into the polymer system is equal to the increase of strain energy by tube deformation [Wagner *et al.* (2001)]. f^2 is found as solution of the evolution equation (with velocity gradient κ and plateau modulus G_N^0),

$$\frac{1}{3kT}\frac{\partial w_{\mathrm{MSF}}}{\partial t} = \kappa:\frac{\sigma}{G_N^0} = f^2(\kappa:S), \tag{6}$$

to be

$$f^2 = e^{\langle \ln u' \rangle_0}, \tag{7}$$

i.e., f^2 is an exponential of the orientational free energy $3kT\langle \ln u' \rangle_0$. Note that by using Eq. (7), the strain energy function of Eq. (5) can be expressed as

$$\frac{w_{\mathrm{LMSF}}}{3kT} = \langle \ln u' \rangle_0 + f^2 - \ln f^2 - 1, \tag{8}$$

i.e., the sum of orientational free energy and stretch energy. The part of the strain energy due to chain stretching has the desired properties, namely, a minimum at equilibrium ($f^2 = 1$) and a quadratic dependence on f^2 in the vicinity of equilibrium.

Since f^2 is linear in the scalar stretch field $L = L_0 e^{\langle \ln u' \rangle_0}$, this is called the "linear" MSF (LMSF) model. The predictions of the LMSF model are in excellent agreement with the uniaxial, equibiaxial and planar viscosities of polydisperse linear polymer melts [Bastian (2001)].

As was shown by Wagner *et al.* (1998) and by Wagner (1999), *long-chain branched* polymer melts do not only show a higher level of strain hardening, but also a steeper slope of the elongational viscosity after the inception of strain hardening, i.e., for Hencky strain $\varepsilon > 1$, compared to the behavior of polydisperse linear melts. Therefore in the case of branched polymer melts, the molecular stress function f increases with an increase in strain faster than predicted by Eq. (7). In terms of the MSF model, this can only be explained by assuming the existence of a softer strain-energy function for branched polymer melts: the same amount of work by the stress tensor will then lead to a higher stretch. Wagner *et al.* (2001) proposed a strain-energy function of the form

$$\frac{w_{\mathrm{MSF}}}{3kT} = \delta(f^2-1) + (1-\delta)\langle \ln u' \rangle_0, \tag{9}$$

where the parameter called δ here with $0 < \delta \leqslant 1$ is a factor that describes the influence of the branching topology on the strain energy. For $\delta = \frac{1}{2}$, f^2 is then given by using Eq. (6) and integration by

$$f^2 = \frac{1}{2}e^{2\langle \ln u' \rangle_0} + \frac{1}{2}. \tag{10}$$

Since f^2 is now quadratic in the scalar stretch field $L = L_0 e^{\langle \ln u' \rangle_0}$, it is called the "quadratic" MSF (QMSF) model, which is in excellent agreement with experimental data for several LDPE melts and a long-chain branched PP melt [Bastian (2001); Wagner

et al. (2002)]. Note that a softer strain-energy function in terms of f^2 indeed results in a stronger strain dependence of the molecular stress function in terms of macroscopic deformation.

While the strain-energy function, Eq. (8), was admittedly empirical in nature, we now propose a new strain-energy function for long-chain branched polymer melts based on the idea that the total strain energy of a branched section of the macromolecular chain is simply given by the addition of the strain energies of β individual chain segments contained in this section. A chain segment is defined here as an entropic entity that gives rise to one entanglement contribution to the plateau modulus within the linear-viscoelastic limit. We start by introducing the following assumption for the strain-energy function of a chain segment in a tube of variable diameter a:

$$\frac{w_{\mathrm{MSF}}}{3kT} = \left|\frac{a_0^2}{a^2} - 1\right| = |f^2 - 1|, \tag{11}$$

or, equivalently,

$$\frac{w_{\mathrm{MSF}}}{3kT} = \left(\frac{a_0^2}{a^2} - 1\right) = (f^2 - 1), \quad \text{for } a < a_0 \text{ and } f^2 > 1, \tag{12a}$$

and

$$\frac{w_{\mathrm{MSF}}}{3kT} = \left(1 - \frac{a_0^2}{a^2}\right) = (1 - f^2), \quad \text{for } a > a_0 \text{ and } f^2 < 1. \tag{12b}$$

Equation (11) guarantees that the equilibrium tube diameter a_0 represents an absolute minimum of the free energy of the polymer system. The free energy of the system relative to equilibrium is increased, if the tube is compressed ($a < a_0$) and the chain segment is stretched ($f^2 > 1$). But the free energy also increases, if the tube is dilated ($a > a_0$) and the chain segment is compressed ($f^2 < 1$). Within the limit of a vanishing end-to-end vector ($f^2 = 0$), a thermal energy of $3kT$ is recovered.

The most simple model of a section of a long-chain branched macromolecule consists of one chain segment oriented in the direction of the tube defined by the "backbone" of the macromolecule, and one or more side chains that represent β-1 crosslinked chain segments (Fig. 11). Note that a side chain can contain more than one chain segment, depending on the length of the side chain relative to the entanglement length. Thus, according to this model, chain segments fall into two distinct categories: either they belong to the backbone and are stretched by deformation, or they do not belong to the backbone and are compressed by deformation. When the tube is stretched, one segment is extended, while β-1 segments are compressed, leading to a total strain energy of

$$\beta\frac{w_{\mathrm{MSF}}}{3kT} = (f^2 - 1) + (\beta - 1)\left(1 - \frac{1}{f^2}\right). \tag{13}$$

We have assumed here for simplicity that chain segments that do no belong to the backbone are oriented "perpendicular" to the backbone, i.e., when the tube segment is stretched by a factor of $f > 1$, the respective end-to-end vector of the compressed chain segments is reduced by a factor of $1/f < 1$. According to Eq. (12b), this leads to the second term on the right-hand side of Eq. (13). The choice of this particular term is of little consequence, as long as it approaches a constant value for larger values of f. Per average chain segment, the resulting strain energy is then

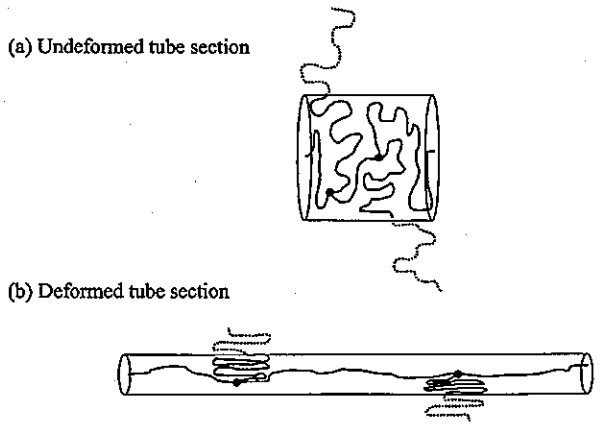


FIG. 11. Schematic of the multichain segment model for $\beta = 3$. (a) Undeformed section of tube and (b) deformed section of tube.

$$\frac{w_{MSF}}{3kT} = \frac{1}{\beta}(f^2-1)+\frac{(\beta-1)}{\beta}\left(1-\frac{1}{f^2}\right). \tag{14}$$

Note that in the vicinity of $f^2 = 1$, this strain-energy function reduces to Eq. (5). The parameter β has values of $\beta \geqslant 1$, with $\beta = 1$ for linear melts. For $\beta = 2$, the resulting molecular stress function is then given by using Eq. (6) and integrating

$$f^2 e^{-(1/2\,1/f^4)} = e^{-(1/2)} e^{2\langle \ln u' \rangle_0} \approx 0.61 e^{2\langle \ln u' \rangle_0}. \tag{15}$$

This agrees closely with the QMSF model predictions of Eq. (10).

So far, we have assumed the limiting elastic case, i.e., the work of the stress tensor is totally stored by tube deformation, and dissipation occurs by relaxation, i.e., reptation of the macromolecules only. Now constraint release (CR) is introduced as a nonlinear dissipative process [Wagner *et al.* (2001)], which modifies the energy balance of tube deformation, and leads to a strain-dependent evolution equation for the molecular stress function of the form

$$\frac{\partial f^2}{\partial t} = \frac{\beta f^2}{1+\dfrac{\beta-1}{f^4}}\left[(\kappa:\mathbf{S})-\frac{1}{f^2-1}\mathrm{CR}\right]. \tag{16}$$

Constraint release is considered to be the consequence of different convection mechanisms for tube orientation and tube cross section, and can be expressed as [Wagner *et al.* (2001)]

$$\mathrm{CR} = \tfrac{1}{2}(f^2-1)^2\left(a_1\sqrt{\mathbf{A}_1^2:\mathbf{S}}+a_2\sqrt{|\mathbf{A}_2:\mathbf{S}-\mathbf{A}_1^2:\mathbf{S}|}\right), \tag{17}$$

where $\mathbf{A}_1^2$ and $\mathbf{A}_2$ are second-order Rivlin–Erickson tensors with

$$\mathbf{A}_1^2 = 4\mathbf{D}^2$$

and

$$\mathbf{A}_2 = \frac{\partial \mathbf{A}_1}{\partial t} + \mathbf{A}_1^2 + 2(\mathbf{WD} + \mathbf{DW}^T), \tag{18}$$

D and W are the rate of deformation and rate of rotation tensor, respectively. Equation (17), which is in accordance with the principle of material objectivity, reduces for constant strain-rate flows to

$$\mathrm{CR} = a_1(f^2-1)^2\sqrt{\mathbf{D}^2:\mathbf{S}} + a_2(f^2-1)^2\sqrt{|\mathbf{WD}:\mathbf{S}|}. \tag{19}$$

The nonlinear material parameters verify $a_1 \geq 0$ and $a_2 \geq 0$.

In extensional flows, $\mathbf{W} = 0$, and constraint release depends on parameter a_1 only. At large strains, $\partial f^2/\partial t = 0$ and a maximum $f^2 = f^2_{\max}$ is reached. Hence, we can express parameter a_1 in terms of $f^2_{\max}$,

$$a_1 = \frac{1}{f^2_{\max}-1}, \tag{20}$$

$f^2_{\max}$ governs the steady-state value of the viscosity in extensional flows. β and $f^2_{\max}$ are the only nonlinear material parameters of the theory that describe polymer melt rheology in nonrotational flow.

The evolution equation for the molecular stress function in constant strain-rate extensional flow is then given by

$$\frac{\partial f^2}{\partial t} = \dot{\varepsilon}\frac{\beta f^2}{1+\dfrac{\beta-1}{f^4}}\left[S_{11} + mS_{22} - (1+m)S_{33} - \frac{f^2-1}{f^2_{\max}-1}\sqrt{S_{11} + m^2S_{22} + (1+m)^2S_{33}}\right], \tag{21}$$

where the parameter $m(-1/2 \leq m \leq 1)$ describes the type of extensional flow, and $\dot{\varepsilon}$ is the largest extension rate. For uniaxial elongation, $m = -1/2$ and $S_{22} = S_{33}$, the evolution equation of the molecular stress function simplifies to

$$\frac{\partial f^2}{\partial t} = \dot{\varepsilon}\frac{\beta f^2}{1+\dfrac{\beta-1}{f^4}}\left[S_{11} - S_{33} - \frac{f^2-1}{f^2_{\max}-1}\sqrt{S_{11} + \frac{1}{2}S_{33}}\right]. \tag{22}$$

The enhanced increase of elongational viscosity of long-chain branched polymer melts in comparison to that in linear melts is caused by the fact that a significant percentage of the chain segments of a long-chain branched molecule is compressed by elongational flow, and only part of the chain segments is stretched. In the multichain segmental MSF model developed here, for one chain segment stretched, β-1 chain segments are compressed.

IV. QUANTITATIVE ANALYSIS OF STRAIN HARDENING OF TUBULAR AND AUTOCLAVE LDPE MELTS

Equations (2) and (22) were implemented in FORTRAN code. Predicted elongational viscosities are compared to experimental data in Figs. 3–10. Excellent agreement within experimental accuracy is found for the tubular LDPE melts (Figs. 3–5), if the multichain segmental MSF model with $\beta = 2$ is used, which is nearly equivalent to the QMSF model of Wagner *et al.* (2001). This agrees with the results of Bastian (2001). The maximum amount of strain hardening, which can only be inferred from the slight bending

over of the elongational viscosity at high strain, increases in the order of tubular LDPE-a ($f^2_{max} = 10$), tubular LDPE-b ($f^2_{max} = 15$), and tubular LDPE-o ($f^2_{max} = 30$). In contrast, the elongational viscosity of autoclave LDPE-D cannot be described by the QMSF model [Fig. 6(a)]: the experimentally observed strain hardening is more pronounced than predicted. Changing to a multichain segmental MSF model of complexity $\beta = 3$ [Fig. 6(b)] improves the predictions considerably. An even slightly better fit can be achieved by use of $\beta = 4$ [Fig. 6(c)]. Independent of the value of β used, the data indicate a plateau of elongational viscosity at $f^2_{max} = 80$.

For autoclave melts LDPE-A (Fig. 7) and LDPE-B (Fig. 8), excellent agreement between the data and the model is achieved for $\beta = 3$ and $f^2_{max} = 70$, whereas there is some indication that autoclave LDPE-C with $\beta = 3$ reaches steady-state elongational viscosity only at a value of f^2_{max} of approximately 100 (Fig. 9).

Autoclave melt LDPE-O clearly shows enhanced strain-hardening behavior with $\beta = 4$ and $f^2_{max} = 80$.

For all melts considered, it is obvious that within the experimentally accessible window of elongation rates, separation of time and strain of measured elongational viscosities is observed. Also, the data are compatible with the implicit assumption in the MSF model that the material parameter f^2_{max} is the same for all relaxation times in the terminal zone of the relaxation spectrum.

V. CONCLUSIONS AND SIGNIFICANCE

Quantitative assessment and comparison of the strain-hardening characteristics of LDPE melts is possible by use of the multichain segmental MSF model. It is based on a minimum of constitutive assumptions: It is based (a) on an expression of the stress tensor, Eq. (2), which is in accordance with general tube model ideas, i.e. the stress depends on a history integral of the orientation tensor multiplied by the square of a stretch function f. (b) The stretch f is related to a reduction in tube diameter, Eq. (1). (c) A reduction of the tube diameter increases the free energy of chain segments according to Eq. (14). (d) The increase of free energy is related to the work of the stress tensor by an energy balance, Eq. (16), which at larger deformation takes into account a nonlinear dissipative process, Eq. (17). In this way, the dynamics of the internal variable f are coupled to macroscopic deformation.

In the multichain segmental model, a chain segment is defined as an entropic entity which, within the linear-viscoelastic limit, gives rise to one entanglement contributing to the plateau modulus. According to the model, chain segments fall into two distinct categories: either they belong to the backbone of the macromolecule and are stretched by nonlinear deformation, or they do not belong to the backbone (i.e., they are oriented "perpendicular" to the backbone) and are compressed by nonlinear deformation. Although this is a very simple coarse-grained model of the complex structure of polydisperse and randomly branched polymer systems, it seems to reveal the essential nonlinear parameters responsible for strain hardening.

The model employs only two nonlinear material parameters with well-defined physical meanings: the parameter β signifies the (average) number of crosslinked chain segments which are correlated and occupy the same backbone tube section. One chain segment, which is oriented in the direction of the backbone tube, is stretched, while $\beta - 1$ chain segments are compressed. In the limit of $\beta = 1$, the model reduces naturally and consistently to the LMSF model for linear polymer melts.

The value of β determines the slope of elongational viscosity after the inception of strain hardening, i.e., for Hencky strains $\varepsilon > 1$. For polydisperse linear melts, consistently a value of $\beta = 1$ was found [Wagner *et al.* (2002)], while the (mostly tubular) LDPE melts investigated by Bastian (2001) can be modeled by $\beta = 2$. This is corroborated by the analysis of the strain hardening behavior of the tubular LDPE-a, -b, and -o melts presented here. The new result is that for more highly branched autoclave LDPE melts, values of $\beta = 3$ and even of 4 are found.

The parameter f_{max}^2 indicates the square of the maximum relative stretch of the chain segments and determines the steady-state (plateau) value of the elongational viscosity. Both parameters β and f_{max}^2 depend on the complex branching topology and polydispersity of LDPE melts. While quantitative relationships between the branching structure and parameters β and f_{max}^2 are not yet available, the results of this comparison seem to indicate that the more tree-like structure of autoclave LDPE leads to a higher density of crosslinked chain segments in the same tube section than the more comb-like structure of LDPE polymerized in tubular reactors.

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STRESS-STRAIN CURVES

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Introduction

Stress-strain curves are an extremely important graphical measure of a material's mechanical properties, and all students of Mechanics of Materials will encounter them often. However, they are not without some subtlety, especially in the case of ductile materials that can undergo substantial geometrical change during testing. This module will provide an introductory discussion of several points needed to interpret these curves, and in doing so will also provide a preliminary overview of several aspects of a material's mechanical properties. However, this module will not attempt to survey the broad range of stress-strain curves exhibited by modern engineering materials (the atlas by Boyer cited in the References section can be consulted for this). Several of the topics mentioned here — especially yield and fracture — will appear with more detail in later modules.

"Engineering" Stress-Strain Curves

Perhaps the most important test of a material's mechanical response is the tensile test[1], in which one end of a rod or wire specimen is clamped in a loading frame and the other subjected to a controlled displacement δ (see Fig. 1). A transducer connected in series with the specimen provides an electronic reading of the load $P(\delta)$ corresponding to the displacement. Alternatively, modern servo-controlled testing machines permit using load rather than displacement as the controlled variable, in which case the displacement $\delta(P)$ would be monitored as a function of load.

The engineering measures of stress and strain, denoted in this module as σ_e and ϵ_e respectively, are determined from the measured the load and deflection using the original specimen cross-sectional area A_0 and length L_0 as

$$\sigma_e = \frac{P}{A_0}, \quad \epsilon_e = \frac{\delta}{L_0} \tag{1}$$

When the stress σ_e is plotted against the strain ϵ_e, an *engineering stress-strain curve* such as that shown in Fig. 2 is obtained.

[1]Stress-strain testing, as well as almost all experimental procedures in mechanics of materials, is detailed by standards-setting organizations, notably the American Society for Testing and Materials (ASTM). Tensile testing of metals is prescribed by ASTM Test E8, plastics by ASTM D638, and composite materials by ASTM D3039.

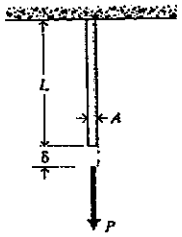


Figure 1: The tension test.

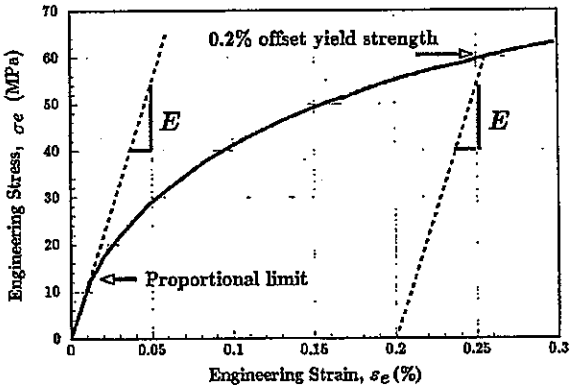


Figure 2: Low-strain region of the engineering stress-strain curve for annealed polycrystaline copper; this curve is typical of that of many ductile metals.

In the early (low strain) portion of the curve, many materials obey Hooke's law to a reasonable approximation, so that stress is proportional to strain with the constant of proportionality being the modulus of elasticity or Young's modulus, denoted E:

$$\sigma_e = E\epsilon_e \tag{2}$$

As strain is increased, many materials eventually deviate from this linear proportionality, the point of departure being termed the proportional limit. This nonlinearity is usually associated with stress-induced "plastic" flow in the specimen. Here the material is undergoing a rearrangement of its internal molecular or microscopic structure, in which atoms are being moved to new equilibrium positions. This plasticity requires a mechanism for molecular mobility, which in crystalline materials can arise from dislocation motion (discussed further in a later module.) Materials lacking this mobility, for instance by having internal microstructures that block dislocation motion, are usually brittle rather than ductile. The stress-strain curve for brittle materials are typically linear over their full range of strain, eventually terminating in fracture without appreciable plastic flow.

Note in Fig. 2 that the stress needed to increase the strain beyond the proportional limit in a ductile material continues to rise beyond the proportional limit; the material requires an ever-increasing stress to continue straining, a mechanism termed *strain hardening.*

These microstructural rearrangements associated with plastic flow are usually not reversed

when the load is removed, so the proportional limit is often the same as or at least close to the materials's elastic limit. Elasticity is the property of complete and immediate recovery from an imposed displacement on release of the load, and the elastic limit is the value of stress at which the material experiences a permanent residual strain that is not lost on unloading. The residual strain induced by a given stress can be determined by drawing an unloading line from the highest point reached on the se - ee curve at that stress back to the strain axis, drawn with a slope equal to that of the initial elastic loading line. This is done because the material unloads elastically, there being no force driving the molecular structure back to its original position.

A closely related term is the yield stress, denoted σ_Y in these modules; this is the stress needed to induce plastic deformation in the specimen. Since it is often difficult to pinpoint the exact stress at which plastic deformation begins, the yield stress is often taken to be the stress needed to induce a specified amount of permanent strain, typically 0.2%. The construction used to find this "offset yield stress" is shown in Fig. 2, in which a line of slope E is drawn from the strain axis at $\epsilon_e = 0.2\%$; this is the unloading line that would result in the specified permanent strain. The stress at the point of intersection with the $\sigma_e - \epsilon_e$ curve is the offset yield stress.

Figure 3 shows the engineering stress-strain curve for copper with an enlarged scale, now showing strains from zero up to specimen fracture. Here it appears that the rate of strain hardening[2] diminishes up to a point labeled UTS, for Ultimate Tensile Strength (denoted σ_f in these modules). Beyond that point, the material appears to strain soften, so that each increment of additional strain requires a smaller stress.

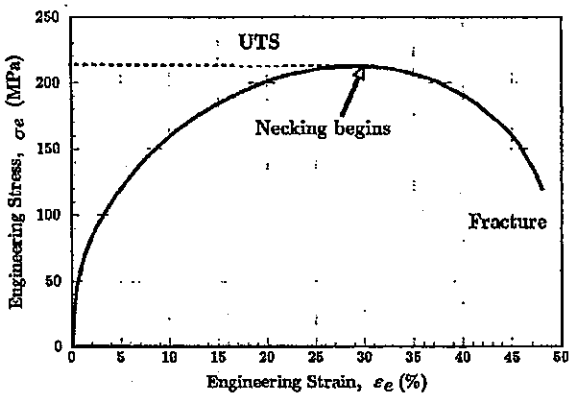


Figure 3: Full engineering stress-strain curve for annealed polycrystalline copper.

The apparent change from strain hardening to strain softening is an artifact of the plotting procedure, however, as is the maximum observed in the curve at the UTS. Beyond the yield point, molecular flow causes a substantial reduction in the specimen cross-sectional area A, so the true stress $\sigma_t = P/A$ actually borne by the material is larger than the engineering stress computed from the original cross-sectional area ($\sigma_e = P/A_0$). The load must equal the true stress times the actual area ($P = \sigma_t A$), and as long as strain hardening can increase σ_t enough to compensate for the reduced area A, the load and therefore the engineering stress will continue to rise as the strain increases. Eventually, however, the decrease in area due to flow becomes larger than the increase in true stress due to strain hardening, and the load begins to fall. This

[2]The strain hardening rate is the slope of the stress-strain curve, also called the *tangent modulus*.

is a geometrical effect, and if the true stress rather than the engineering stress were plotted no maximum would be observed in the curve.

At the UTS the differential of the load P is zero, giving an analytical relation between the true stress and the area at necking:

$$P = \sigma_t A \rightarrow dP = 0 = \sigma_t dA + A d\sigma_t \rightarrow -\frac{dA}{A} = \frac{d\sigma_t}{\sigma_t} \tag{3}$$

The last expression states that the load and therefore the engineering stress will reach a maximum as a function of strain when the fractional decrease in area becomes equal to the fractional increase in true stress.

Even though the UTS is perhaps the materials property most commonly reported in tensile tests, it is not a direct measure of the material due to the influence of geometry as discussed above, and should be used with caution. The yield stress σ_Y is usually preferred to the UTS in designing with ductile metals, although the UTS is a valid design criterion for brittle materials that do not exhibit these flow-induced reductions in cross-sectional area.

The true stress is not quite uniform throughout the specimen, and there will always be some location - perhaps a nick or some other defect at the surface - where the local stress is maximum. Once the maximum in the engineering curve has been reached, the localized flow at this site cannot be compensated by further strain hardening, so the area there is reduced further. This increases the local stress even more, which accelerates the flow further. This localized and increasing flow soon leads to a "neck" in the gage length of the specimen such as that seen in Fig. 4.



Figure 4: Necking in a tensile specimen.

Until the neck forms, the deformation is essentially uniform throughout the specimen, but after necking all subsequent deformation takes place in the neck. The neck becomes smaller and smaller, local true stress increasing all the time, until the specimen fails. This will be the failure mode for most ductile metals. As the neck shrinks, the nonuniform geometry there alters the uniaxial stress state to a complex one involving shear components as well as normal stresses. The specimen often fails finally with a "cup and cone" geometry as seen in Fig. 5, in which the outer regions fail in shear and the interior in tension. When the specimen fractures, the engineering strain at break — denoted ϵ_f — will include the deformation in the necked region and the unnecked region together. Since the true strain in the neck is larger than that in the unnecked material, the value of ϵ_f will depend on the fraction of the gage length that has necked. Therefore, ϵ_f is a function of the specimen geometry as well as the material, and thus is only a

crude measure of material ductility.

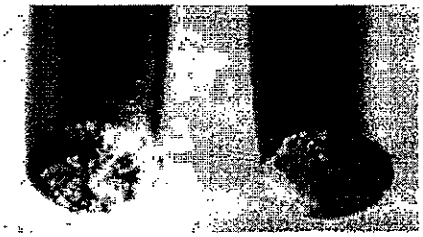


Figure 5: Cup-and-cone fracture in a ductile metal.

Figure 6 shows the engineering stress-strain curve for a semicrystalline thermoplastic. The response of this material is similar to that of copper seen in Fig. 3, in that it shows a proportional limit followed by a maximum in the curve at which necking takes place. (It is common to term this maximum as the yield stress in plastics, although plastic flow has actually begun at earlier strains.)

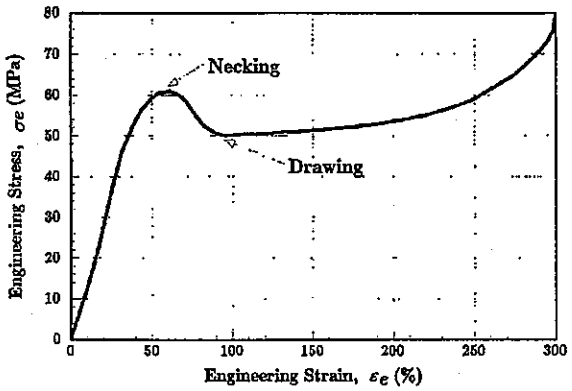


Figure 6: Stress-strain curve for polyamide (nylon) thermoplastic.

The polymer, however, differs dramatically from copper in that the neck does not continue shrinking until the specimen fails. Rather, the material in the neck stretches only to a "natural draw ratio" which is a function of temperature and specimen processing, beyond which the material in the neck stops stretching and new material at the neck shoulders necks down. The neck then propagates until it spans the full gage length of the specimen, a process called *drawing*. This process can be observed without the need for a testing machine, by stretching a polyethylene "six-pack holder," as seen in Fig. 7.

Not all polymers are able to sustain this drawing process. As will be discussed in the next section, it occurs when the necking process produces a strengthened microstructure whose breaking load is greater than that needed to induce necking in the untransformed material just outside the neck.

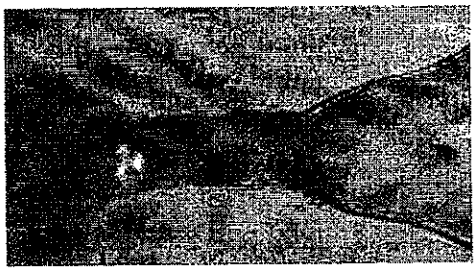


Figure 7: Necking and drawing in a 6-pack holder.

"True" Stress-Strain Curves

As discussed in the previous section, the engineering stress-strain curve must be interpreted with caution beyond the elastic limit, since the specimen dimensions experience substantial change from their original values. Using the true stress $\sigma_t = P/A$ rather than the engineering stress $\sigma_e = P/A_0$ can give a more direct measure of the material's response in the plastic flow range. A measure of strain often used in conjunction with the true stress takes the increment of strain to be the incremental increase in displacement dL divided by the current length L:

$$d\epsilon_t = \frac{dL}{l} \rightarrow \epsilon_t = \int_{l_0}^{L} \frac{1}{L}\, dL = \ln \frac{L}{L_0} \tag{4}$$

This is called the "true" or "logarithmic" strain.

During yield and the plastic-flow regime following yield, the material flows with negligible change in volume; increases in length are offset by decreases in cross-sectional area. Prior to necking, when the strain is still uniform along the specimen length, this volume constraint can be written:

$$dV = 0 \rightarrow AL = A_0 L_0 \rightarrow \frac{L}{L_0} = \frac{A}{A_0} \tag{5}$$

The ratio L/L_0 is the *extension ratio,* denoted as λ. Using these relations, it is easy to develop relations between true and engineering measures of tensile stress and strain (see Prob. 2):

$$\sigma_t = \sigma_e\,(1 + \epsilon_e) = \sigma_e \lambda, \quad \epsilon_t = \ln\,(1 + \epsilon_e) = \ln\,\lambda \tag{6}$$

These equations can be used to derive the true stress-strain curve from the engineering curve, up to the strain at which necking begins. Figure 8 is a replot of Fig. 3, with the true stress-strain curve computed by this procedure added for comparison.

Beyond necking, the strain is nonuniform in the gage length and to compute the true stress-strain curve for greater engineering strains would not be meaningful. However, a complete true stress-strain curve could be drawn if the neck area were monitored throughout the tensile test, since for logarithmic strain we have

$$\frac{L}{L_0} = \frac{A}{A_0} \rightarrow \epsilon_t = \ln \frac{L}{L_0} = \ln \frac{A}{A_0} \tag{7}$$

Ductile metals often have true stress-strain relations that can be described by a simple power-law relation of the form:

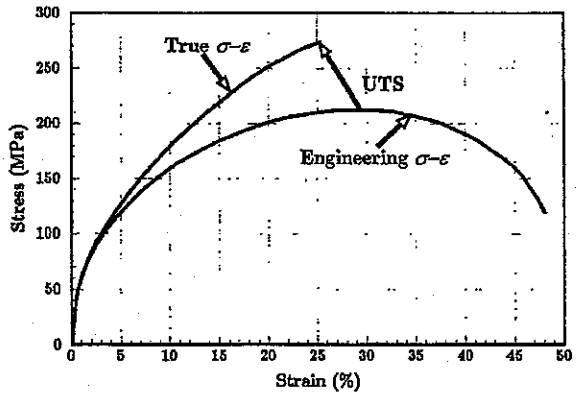


Figure 8: Comparison of engineering and true stress-strain curves for copper. An arrow indicates the position on the "true" curve of the UTS on the engineering curve.

$$\sigma_t = A\epsilon_t^n \rightarrow \log \sigma_t = \log A + n \log \epsilon_t \tag{8}$$

Figure 9 is a log-log plot of the true stress-strain data[3] for copper from Fig. 8 that demonstrates this relation. Here the parameter $n = 0.474$ is called the *strain hardening parameter*, useful as a measure of the resistance to necking. Ductile metals at room temperature usually exhibit values of n from 0.02 to 0.5.

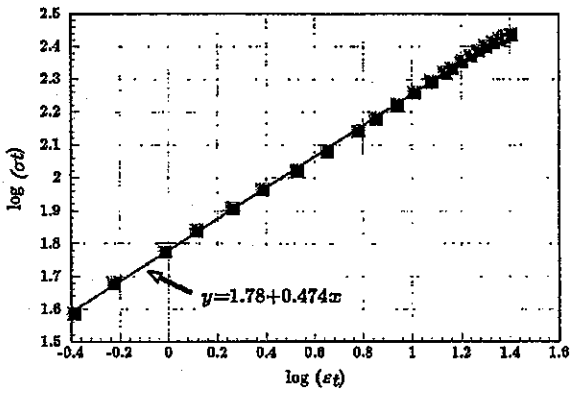


Figure 9: Power-law representation of the plastic stress-strain relation for copper.

A graphical method known as the "Considère construction" uses a form of the true stress-strain curve to quantify the differences in necking and drawing from material to material. This method replots the tensile stress-strain curve with true stress σ_t as the ordinate and extension ratio $\lambda = L/L_0$ as the abscissa. From Eqn. 6, the engineering stress σ_e corresponding to any

[3]Here percent strain was used for ϵ_t; this produces the same value for n but a different A than if full rather than percentage values were used.

value of true stress σ_t is slope of a secant line drawn from origin ($\lambda = 0$, not $\lambda = 1$) to intersect the $\sigma_t - \lambda$ curve at σ_t.

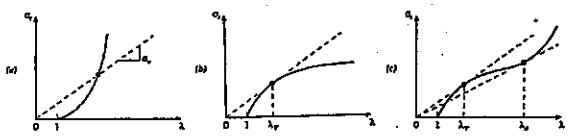


Figure 10: Considère construction. (a) True stress-strain curve with no tangents - no necking or drawing. (b) One tangent - necking but not drawing. (c) Two tangents - necking and drawing.

Among the many possible shapes the true stress-strain curves could assume, let us consider the concave up, concave down, and sigmoidal shapes shown in Fig. 10. These differ in the number of tangent points that can be found for the secant line, and produce the following yield characteristics:

(a) *No tangents:* Here the curve is always concave upward as in part (a) of Fig. 10, so the slope of the secant line rises continuously. Therefore the engineering stress rises as well, without showing a yield drop. Eventually fracture intercedes, so a true stress-strain curve of this shape identifies a material that fractures before it yields.

(b) *One tangent:* The curve is concave downward as in part (b) of Fig. 10, so a secant line reaches a tangent point at $\lambda = \lambda_Y$. The slope of the secant line, and therefore the engineering stress as well, begins to fall at this point. This is then the yield stress σ_Y seen as a maximum in stress on a conventional stress-strain curve, and λ_Y is the extension ratio at yield. The yielding process begins at some adventitious location in the gage length of the specimen, and continues at that location rather than being initiated elsewhere because the secant modulus has been reduced at the first location. The specimen is now flowing at a single location with decreasing resistance, leading eventually to failure. Ductile metals such as aluminum fail in this way, showing a marked reduction in cross sectional area at the position of yield and eventual fracture.

(c) *Two tangents:* For sigmoidal stress-strain curves as in part (c) of Fig. 10, the engineering stress begins to fall at an extension ration λ_Y, but then rises again at λ_d. As in the previous one-tangent case, material begins to yield at a single position when $\lambda = \lambda_Y$, producing a neck that in turn implies a nonuniform distribution of strain along the gage length. Material at the neck location then stretches to λ_d, after which the engineering stress there would have to rise to stretch it further. But this stress is greater than that needed to stretch material at the edge of the neck from λ_Y to λ_d, so material already in the neck stops stretching and the neck propagates outward from the initial yield location. Only material within the neck shoulders is being stretched during propagation, with material inside the necked-down region holding constant at λ_d, the material's "natural draw ratio," and material outside holding at λ_Y. When all the material has been drawn into the necked region, the stress begins to rise uniformly in the specimen until eventually fracture occurs.

The increase in strain hardening rate needed to sustain the drawing process in semicrystalline polymers arises from a dramatic transformation in the material's microstructure. These materials are initially "spherulitic," containing flat lamellar crystalline plates, perhaps 10 nm

thick, arranged radially outward in a spherical domain. As the induced strain increases, these spherulites are first deformed in the straining direction. As the strain increases further, the spherulites are broken apart and the lamellar fragments rearranged with a dominantly axial molecular orientation to become what is known as the fibrillar microstructure. With the strong covalent bonds now dominantly lined up in the load-bearing direction, the material exhibits markedly greater strengths and stiffnesses — by perhaps an order of magnitude — than in the original material. This structure requires a much higher strain hardening rate for increased strain, causing the upturn and second tangent in the true stress-strain curve.

Strain energy

The area under the $\sigma_e - \epsilon_e$ curve up to a given value of strain is the total mechanical energy per unit volume consumed by the material in straining it to that value. This is easily shown as follows:

$$U^* = \frac{1}{V}\int P\,dL = \int_0^L \frac{P}{A_0}\frac{dL}{L_0} = \int_0^\epsilon \sigma\,d\epsilon \tag{9}$$

In the absence of molecular slip and other mechanisms for energy dissipation, this mechanical energy is stored reversibly within the material as strain energy. When the stresses are low enough that the material remains in the elastic range, the strain energy is just the triangular area in Fig. 11:

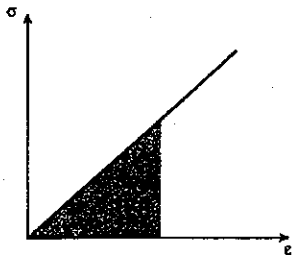


Figure 11: Strain energy = area under stress-strain curve.

Note that the strain energy increases quadratically with the stress or strain; i.e. that as the strain increases the energy stored by a given increment of additional strain grows as the square of the strain. This has important consequences, one example being that an archery bow cannot be simply a curved piece of wood to work well. A real bow is initially straight, then bent when it is strung; this stores substantial strain energy in it. When it is bent further on drawing the arrow back, the energy available to throw the arrow is very much greater than if the bow were simply carved in a curved shape without actually bending it.

Figure 12 shows schematically the amount of strain energy available for two equal increments of strain $\Delta\epsilon$, applied at different levels of existing strain.

The area up to the yield point is termed the *modulus of resilience,* and the total area up to fracture is termed the *modulus of toughness;* these are shown in Fig. 13. The term "modulus" is used because the units of strain energy per unit volume are N-m/m^3 or N/m^2, which are the same as stress or modulus of elasticity. The term "resilience" alludes to the concept that up to the point of yielding, the material is unaffected by the applied stress and upon unloading

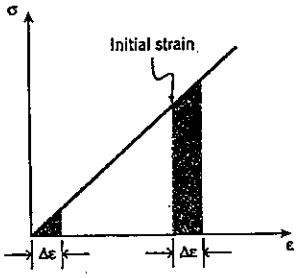


Figure 12: Energy associated with increments of strain

Table 1: Energy absorption of various materials.

Material	Maximum Strain, %	Maximum Stress, MPa	Modulus of Toughness, MJ/m^3	Density kg/m^3	Max. Energy J/kg
Ancient Iron	0.03	70	0.01	7,800	1.3
Modern spring steel	0.3	700	1.0	7,800	130
Yew wood	0.3	120	0.5	600	900
Tendon	8.0	70	2.8	1,100	2,500
Rubber	300	7	10.0	1,200	8,000

will return to its original shape. But when the strain exceeds the yield point, the material is deformed irreversibly, so that some residual strain will persist even after unloading. The modulus of resilience is then the quantity of energy the material can absorb without suffering damage. Similarly, the modulus of toughness is the energy needed to completely fracture the material. Materials showing good impact resistance are generally those with high moduli of toughness.

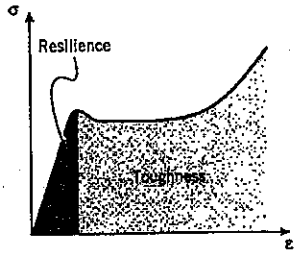


Figure 13: Moduli of resilience and toughness.

Table 1[4] lists energy absorption values for a number of common materials. Note that natural and polymeric materials can provide extremely high energy absorption per unit weight.

During loading, the area under the stress-strain curve is the strain energy per unit volume absorbed by the material. Conversely, the area under the unloading curve is the energy released by the material. In the elastic range, these areas are equal and no net energy is absorbed. But

[4]J.E. Gordon, *Structures, or Why Things Don't Fall Down*, Plenum Press, New York, 1978.

if the material is loaded into the plastic range as shown in Fig. 14, the energy absorbed exceeds the energy released and the difference is dissipated as heat.

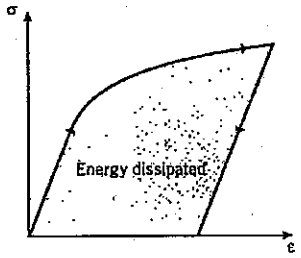


Figure 14: Energy loss = area under stress-strain loop.

Compression

The above discussion is concerned primarily with simple tension, i.e. uniaxial loading that increases the interatomic spacing. However, as long as the loads are sufficiently small (stresses less than the proportional limit), in many materials the relations outlined above apply equally well if loads are placed so as to put the specimen in compression rather than tension. The expression for deformation and a given load $\delta = PL/AE$ applies just as in tension, with negative values for δ and P indicating compression. Further, the modulus E is the same in tension and compression to a good approximation, and the stress-strain curve simply extends as a straight line into the third quadrant as shown in Fig. 15.

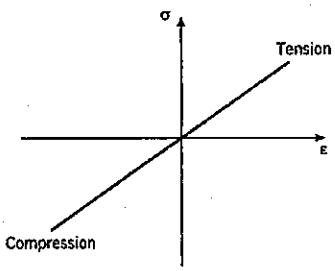


Figure 15: Stress-strain curve in tension and compression.

There are some practical difficulties in performing stress-strain tests in compression. If excessively large loads are mistakenly applied in a tensile test, perhaps by wrong settings on the testing machine, the specimen simply breaks and the test must be repeated with a new specimen. But in compression, a mistake can easily damage the load cell or other sensitive components, since even after specimen failure the loads are not necessarily relieved.

Specimens loaded cyclically so as to alternate between tension and compression can exhibit hysteresis loops if the loads are high enough to induce plastic flow (stresses above the yield stress). The enclosed area in the loop seen in Fig. 16 is the strain energy per unit volume released as heat in each loading cycle. This is the well-known tendency of a wire that is being

bent back and forth to become quite hot at the region of plastic bending. The temperature of the specimen will rise according to the magnitude of this internal heat generation and the rate at which the heat can be removed by conduction within the material and convection from the specimen surface.

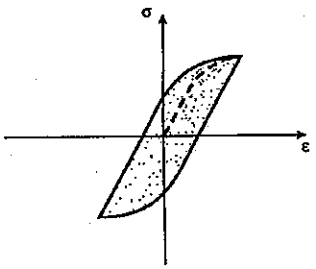


Figure 16: Hysteresis loop.

Specimen failure by cracking is inhibited in compression, since cracks will be closed up rather than opened by the stress state. A number of important materials are much stronger in compression than in tension for this reason. Concrete, for example, has good compressive strength and so finds extensive use in construction in which the dominant stresses are compressive. But it has essentially no strength in tension, as cracks in sidewalks and building foundations attest: tensile stresses appear as these structures settle, and cracks begin at very low tensile strain in unreinforced concrete.

References

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2. Courtney, T.H., *Mechanical Behavior of Materials,* McGraw-Hill, New York, 1990.

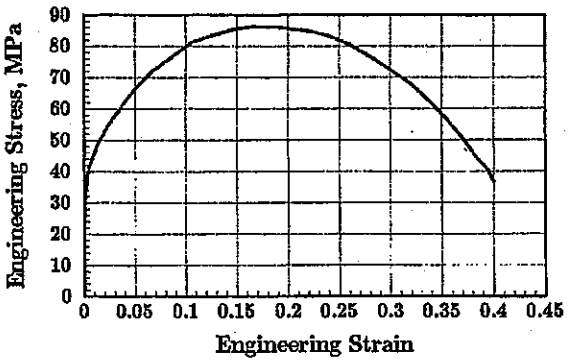
3. Hayden, H.W., W.G. Moffatt and J. Wulff, *The Structure and Properties of Materials: Vol. III Mechanical Behavior,* Wiley, New York, 1965.

Problems

1. The figure below shows the engineering stress-strain curve for pure polycrystalline aluminum; the numerical data for this figure are in the file `aluminum.txt`, which can be imported into a spreadsheet or other analysis software. For this material, determine (a) Young's modulus, (b) the 0.2% offset yield strength, (c) the Ultimate Tensile Strength (UTS), (d) the modulus of resilience, and (e) the modulus of toughness.

2. Develop the relations given in Eqn. 6:

$$\sigma_t = \sigma_e (1 + \epsilon_e) = \sigma_e \lambda, \quad \epsilon_t = \ln (1 + \epsilon_e) = \ln \lambda$$



Prob. 1

3. Using the relations of Eqn. 6, plot the true stress-strain curve for aluminum (using data from Prob.1) up to the strain of neck formation.

4. Replot the the results of the previous problem using log-log axes as in Fig. 9 to determine the parameters A and n in Eqn. 8 for aluminum.

5. Using Eqn. 8 with parameters $A = 800$ MPa, $n = 0.2$, plot the engineering stress-strain curve up to a strain of $\epsilon_e = 0.4$. Does the material neck? Explain why the curve is or is not valid at strains beyond necking.

6. Using the parameters of the previous problem, use the condition $(d\sigma_e/d\epsilon_e)_{\text{neck}} = 0$ to show that the engineering strain at necking is $\epsilon_{e,neck} = 0.221$.

7. Use a Considère construction (plot σ_t vs. λ, as in Fig. 10) to verify the result of the previous problem.

8. Elastomers (rubber) have stress-strain relations of the form

$$\sigma_e = \frac{E}{3}\left(\lambda - \frac{1}{\lambda^2}\right),$$

where E is the initial modulus. Use the Considère construction to show whether this material will neck, or draw.

9. Show that a power-law material (one obeying Eqn. 8) necks when the true strain ϵ_t becomes equal to the strain-hardening exponent n.

10. Show that the UTS (engineering stress at incipient necking) for a power-law material (Eqn. 8) is

$$\sigma_f = \frac{An^n}{e^n}$$

11. Show that the strain energy $U = \int \sigma \, d\epsilon$ can be computed using either engineering or true values of stress and strain, with equal result.

12. Show that the strain energy needed to neck a power-law material (Eqn.8) is

$$U = \frac{An^{n+1}}{n+1}$$

Biaxial Orientation of Poly(ethylene Terephthalate). Part II: The Strain-Hardening Parameter

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ABSTRACT

Results of a study of the orientation characteristics of extruded poly(ethylene terephthalate) (PET) (homopolymer) sheets are discussed with respect to stretching conditions. PET exhibits strain-induced crystallization upon being stretched to large extension ratios. This may lead to strain-hardening, which is accompanied by an upswing in the stress–strain curve recorded during the process of extension. A parameter pertaining to the extension ratio, at which the onset of strain-hardening occurs during stretching of the specimen, is defined. This is called the strain-hardening parameter (SHP). The dependence of the SHP on the mode of stretching, the temperature of stretching, the strain rate, and the limiting extension ratio in the first stretch direction, are studied. It is seen that the SHP in both simultaneous and sequential modes decreases with increasing strain rate and the limiting extension ratio in the first stretch direction, while it increases with increasing temperature of stretching. For specimens stretched in the simultaneous mode at 90°C, SHP versus extension rate shows a minimum. This could be due to viscous dissipation at high rates of extension. Also studied is the relationship of strain-hardening and the SHP with strain-induced crystallization. It is seen that for specimens stretched in the uniaxial constrained mode, the rapid increase in properties with extension occurs much before the upswing in the stress–strain curve. The upswing occurs at the extension ratio at which the increase in properties once again becomes gradual. This means that the upswing in the stress–strain curve indicates significant completion of strain-induced crystallization and the establishment of structural order within the specimen. © 1993 John Wiley & Sons, Inc.

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Introduction

In Part I of this study, the stress–strain curve obtained during orientation of PET has been investigated extensively. From this work, it was clearly demonstrated that at high extension ratios, there is an upswing in stress versus strain. This upswing has been characterized as the onset of strain-hardening. Strain-hardening has an important effect on the manufacturing of oriented films and blow molded containers. The specific effect is that it enables the production of uniform thickness distribution in oriented articles.

Bonnebat et al.[1] studied the uni- and biaxial stretching of PET specimens at temperatures near the glass–rubber transition. They concluded that stretching under these conditions may lead to non-uniform stretching unless the draw ratio exceeds a critical value, the natural draw ratio, which is characteristic of the onset of strain-hardening.[1] This onset of strain-hardening is accompanied by an upswing in the stress–strain curve. After the onset, strain-hardening continues upon further extension. The load then rises at a steady rate, with elongation.[2] The value of the natural draw ratio depends upon the I.V. (inherent viscosity) of the polymeric material stretched, the stretching temperature, the strain rate of stretching, and the extension ratios in the directions of stretching.[1]

A typical stress–strain curve, obtained during the stretching of PET above its glass transition temperature, is represented by Figure 1. The stress–strain curve shows an upswing at large extension under suitable orientation conditions. This upswing in the stress–strain curve indicates the onset of strain-hardening. Bonnebat et al.[1] called the extension ratio at the onset of strain-hardening, the natural draw ratio. In an attempt to consistently measure the extension ratio at the onset of strain-hardening, this study defines a parameter associated with the onset of strain-hardening, as the strain-hardening parameter (SHP). The strain-hardening parameter has been introduced as a means of correlating the occurrence of the upswing in the stress–strain curve with the orientation conditions.

The calculation of the strain-hardening parameter, in this study, is as explained below (please refer to Figure 1 for the geometric constructions performed in the calculation of the SHP):

- Extend a line from the constant slope in the plateau region (line AB).
- Extend a line from the constant slope after the upswing (line CD), such that it intersects the previous line (point E).
- Bisect the angle formed by the intersection of the above lines (line EF).
- Extend a line along the bisector (line EF), such that it intersects the stress–strain curve (point G).
- Find the extension ratio at this point of intersection (point H, obtained by dropping perpendicular GH to the X-axis).

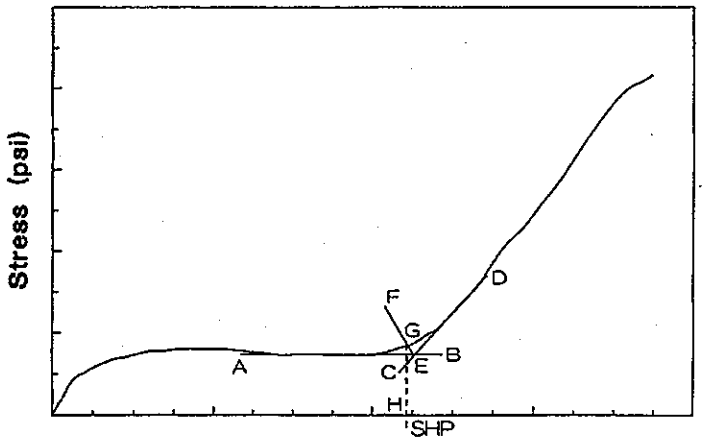


FIGURE 1. Definition of the Strain-Hardening Parameter (SHP) from the stress–strain curve.

This extension ratio is the value of the strain-hardening parameter (SHP). During uniaxial extension, the SHP is measured in the direction of stretching. In the case of biaxial extension, the stress–strain curve is recorded while stretching along axis 2 (in the second stretch direction). Hence, the SHP is measured in the second direction.

Knowledge of the value of the SHP, under a given set of stretching conditions, is important, in determining the extension ratios required to achieve uniformity of wall thickness and properties in the final product. It would thus help to determine the optimum hoop and axial extension ratios for a particular parison used in the process of blow molding. The first objective of this work is then to investigate fully the dependence of the strain-hardening parameter on processing variables such as temperature, strain rate, extension ratio, and the mode of extension. PET sheet of the same I.V. has been used throughout the present study. Hence, the dependence of the SHP on the I.V. of the material has not been studied.

Poly(ethylene terephthalate), PET, is a polymer that exhibits strain-induced crystallization upon substantial orientation. Upon stretching, alignment of the polymer chains can result in a high degree of orientation in the direction of deformation.[3,4] In the case of PET, this alignment and orientation leads to strain-induced crystallization.[2,4,5]

Ward[6] propounded that the basic physical idea in the phenomenon of strain-induced crystallization is that the melting point T of the polymer is increased due to extension. Now, $T = \Delta H/\Delta S$, where ΔH and ΔS are the enthalpy and entropy of fusion, respectively. Because the entropy of the extended polymer is low, the change in entropy on crystallization is reduced and T is correspondingly increased. This higher degree of supercooling then gives rise to crystallization and the crystallites act to increase the modulus by forming additional physical crosslinks.

The origin of the SHP and its relationship with strain-induced crystallization is not understood. A number of workers[2,5–14] have studied the changes in properties associated with orientation occurring during uniaxial and biaxial stretching. A detailed account of the work done in the characterization and measurement of the degree of orientation in relationship to the macroscopic deformation conditions, and their effects on mechanical properties, can be found in publications by Samuels[15] and Ward.[6] In a few previous publications, researchers have speculated that strain-hardening is associated with the beginning of strain-induced crystallization. However, no specific data or correlations are given in the literature. Charch and Mosely[16] conducted sonic measurements on uniaxially elongated nylon 6,6 fibers. Sonic velocity and x-ray diffraction data showed that increases in molecular orientation built up most rapidly during the time when stress increased the least, and only small increases in orientation occurred at the higher ends of the stress–strain curves, i.e., at large elongations. Hence, the second objective of the current work is to compare changes in density, birefringence, infrared absorption, x-ray diffraction, and mechanical properties, with changes in the stress measured during stretching. The trend of the property changes in the vicinity of the upswing in the stress–strain curve would help to gauge the importance of the strain–hardening parameter as an indicator of the prevalence of structural order in the polymer. This would help in identifying the correlation between the SHP and strain-induced crystallization.

Experimental

The material used in this part of the work is the same as that used in Part I of this study.[17] Uniaxial and biaxial orientation was performed on the Long Extension Tester (LET®). Details of the LET and its operation can be found in Part I of this study.[17] Also, the methods of specimen preparation and conditioning have been discussed in detail in Part I of the study.[17]

Stress–strain curves for specimens stretched under various combinations of orientation conditions were recorded in Part I of this study.[17] The SHPs were calculated for each of the stress–strain curves, using the method described above.

MEASUREMENT OF PROPERTIES

Mechanical Properties

The tensile mechanical properties were determined using an Instron Tensile Tester, at 23°C and at a crosshead speed of 1 in./min. ASTM D-1708 procedures were followed.

Density

Density of the samples was measured using an aqueous calcium nitrate and water density gradient column, at a temperature of 25 ± 1°C. The gradient column was calibrated by suspending glass beads of known densities in the column. Procedures similar to ASTM D-1505 were followed. The film specimens attained equilibrium in the column after 75 min. Accuracy of measurement was within 0.0008 g/cc.

Birefringence

The birefringence was calculated from the refractive indices measured in the three principal directions using an Abbe-3L refractometer equipped with a polarizing eyepiece, according to the method of Okajima and Koizumi[18] as described by Schael.[19] The temperature was maintained at 25 ± 1°C.

For a sample stretched in the biaxial or the constrained uniaxial mode, three birefringences exist with respect to the principal directions 1, 2, and 3. Two of these are independent.

$$\Delta_{13} = n_1 - n_3$$

$$\Delta_{23} = n_2 - n_3$$

$$\Delta_{21} = n_2 - n_1 = n_{23} - n_{13}$$

Therefore, one needs at least two birefringence indices in two planes in order to completely specify the orientation in the sample.

Infrared Spectrophotometry

Test specimens measuring 10 mm × 48 mm were cut from the stretched samples (ensuring that the edges of the test specimen were cut parallel to the edges of the sample), and placed on both sides of a 50 mm × 20 mm × 2 mm 45°, KRS-5 internal reflection element mounted in a Harrick internal reflectance accessory. The accessory was placed in a Harrick TMP-V-POB twin parallel mirror reflectance attachment. Spectra were recorded on a Perkin-Elmer Model 1600 FTIR-Series spectrophotometer, at 4 cm^{-1} resolution.

The spectrum is sensitive to any treatment of the polymer which changes the crystallinity, the molecular conformation, or the molecular orientation. The assignment of spectral bands to group vibrations in PET is generally accepted as given in Table I.[20,21]

TABLE I

Absorption Frequency (cm^{-1})	Absorbing Group
973	C-O stretch of *trans* ethylene glycol units
896	CH_2 rocking of *gauche* ethylene glycol units
848	CH_2 rocking of *trans* ethylene glycol units
793	aromatic ring

An increase in crystallinity is correlated with a decrease in the amount of PET with ethylene glycol units in the gauche, or relaxed form, and an increase in the amount of ethylene glycol units in the trans, or extended form.[20] Hence, an increase in the height of the peak at an absorption frequency of 973 cm^{-1} indicates an increase in the crystallinity within the sample. Similarly, an increase in the height of the peak at an absorption frequency of 848 cm^{-1} indicates an increase in crystallinity while an increase in the height of the peak at an absorption frequency of 896 cm^{-1} indicates a decrease in the crystallinity of the sample. The height of the peak at an absorption frequency of 793 cm^{-1} is not sensitive to changes in conformation. It has been used as a normalizing factor in the comparison of the various peak heights in two different samples.

X-ray Diffraction

X-ray diffraction measurements were made using a Phillips x-ray diffractometer, with Cu K-α radiation (graphite monochrometer), at 35 kV and 20 mA. Step scanning was used, and counts were recorded for a duration of 1 s at 2θ intervals of 0.02°. The counts measured per second were recorded at each value of 2θ, to obtain scans of counts measured per second versus 2θ. Scanning was done over a 2θ range from 10° to 50°. During this measurement, the incident x-ray beam strikes the sample at an angle of incident θ. The diffracted beam, at an angle θ, represents x-ray traces diffracted from planes in the sample's thickness direction. In this arrangement, the diffracted x-ray peaks satisfy the Bragg's Law $\lambda = 2d \sin\theta$; where λ is the x-ray wavelength and d is the spacing. Therefore, in this arrangement, the x-ray diffracted beam gives a measure of the order in the thickness direction of the sample and is independent of sample orientation.

Results and Discussion

THE STRAIN-HARDENING PARAMETER IN SIMULTANEOUS BIAXIAL ORIENTATION

A plot of the strain-hardening parameter, SHP, versus the limiting extension ratio allowed in the first stretch direction, for specimens stretched in the simultaneous mode at 90°C and at various extension rates, is shown in Figure 2. The limiting extension ratio allowed in the first stretch direction has been called the 1st-Extension ratio. It is seen that the SHP versus 1st-Extension ratio curve is sigmoidal in shape. Now, a limiting extension ratio of 1.0, in the first stretch direction essentially means constrained uniaxial extension along the second direction. It is seen from Figure 2 that the SHP for a specimen stretched at an extension rate of 0.1 in./s, and to a 1st-Extension ratio of 1.0, is about 4.10. When compared at the same extension rate, the SHP then decreases as the 1st-Extension ratio increases, until it attains a steady value at high limiting extension ratios in the first stretch direction. At any extension rate, there is a critical 1st-Extension ratio beyond which the SHP has a constant value. This is the extension ratio at which strain-hardening occurs during stretching in the equal biaxial simultaneous mode. For specimens with higher 1st-Extension ratios than this critical value, strain-hardening will still occur at the same planar extension during stretching in the equal biaxial simultaneous mode. As a result, the SHP attains a constant value after the critical 1st-Extension ratio. Further, the decrease in SHP with increasing 1st-Extension ratio is because the total planar extension of a specimen with a higher 1st-Extension ratio is higher than that of a specimen with a lower 1st-Extension ratio, when both are compared at the same extension ratio in the second direction.

A plot of SHP versus extension rate is shown in Figure 3. Each curve in the figure represents stretching to a particular limiting extension ratio in the first stretch direction. The various limiting extension ratios or 1st-Extension ratios are given in the key to the figure. We see that for specimens stretched at 90°C in the simultaneous biaxial mode, the SHP versus extension rate curve is concave upward in shape. The SHP decreases initially as the strain rate increases, reaches a minimum, and then increases with strain rate. This minimum in the SHP versus strain rate curve is not seen for specimens stretched in the constrained uniaxial mode. In the constrained uniaxial model, SHP decreases steadily over the range of strain rates used, until it attains a constant value at high strain rates.

Figure 4 shows a plot of SHP versus extension rate, for specimens stretched in the simultaneous biaxial mode at 100°C, to various extension ratios

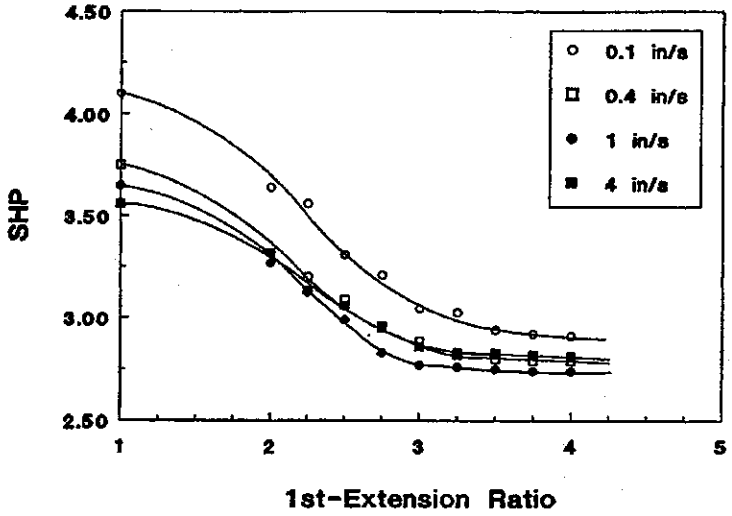


FIGURE 2. SHP vs. the limiting extension ratio in the first stretch direction, for specimens stretched in the biaxial simultaneous mode at 90°C and at different rates of extension.

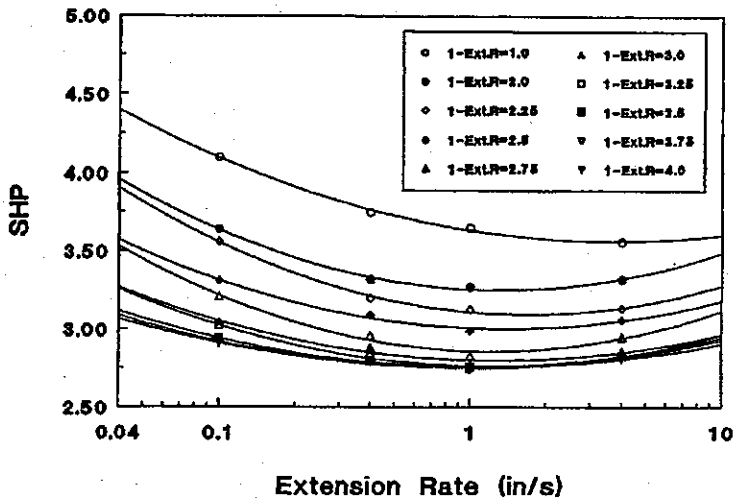


FIGURE 3. SHP vs. extension rate, for specimens stretched in the biaxial simultaneous mode at 90°C and to different limiting extension ratios in the first stretch direction.

in the first direction. The SHP decreases steadily as the strain rate increases, until it attains a constant value at high strain rates. The SHP versus extension rate curve is again concave upward, but does not go to a minimum at higher strain rates, as it did for samples stretched in the simultaneous biaxial mode at 90°C.

From results of deformation studies on cold drawn, amorphous PET, Misra and Stein[22] have suggested the possibility of local heating during the drawing process, caused by viscous dissipation. Marshall and Thompson[23] observed that in the cold drawing of polymer filaments, the shoulders of the neck, where the extension occurs, attain a high temperature. This was evidenced by the vaporization of a film of water on the surface of

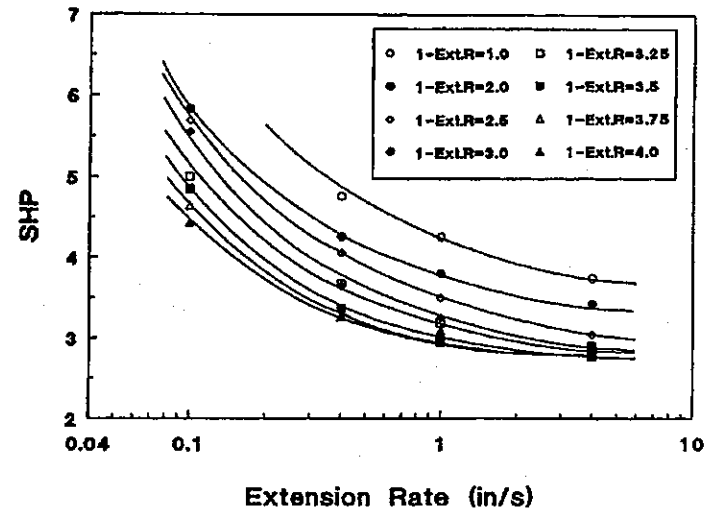


FIGURE 4. SHP vs. extension rate, for specimens stretched in the biaxial simultaneous mode at 100°C and to different limiting extension ratios in the first stretch direction.

the filaments, from the shoulders exclusively. Marshall and Thompson reasoned that the work done in stretching the polymer must appear as an increase in elastic potential energy or as heat. Previous studies by Treloar[24] have shown that the work stored as elastic potential energy is small, and the bulk must appear as heat, which will cause a rise in local temperature in the specimen. The liberation of latent heat on crystallization would further add to this rise in temperature.

Warner[25] modeled the drawing behavior of PET fibers, and concluded that stretching can result in significant increases in local temperatures. His model predicted that the dissipation of the generated heat is directly proportional to the difference between the stretch temperature and ambient temperature, and is inversely proportional to the rate of extension. The increase in local temperature with stretching, would then increase either with increasing rates of stretching, or with decreasing stretch temperatures. Subsequent work by Maruhashi et al.[26] confirms this fact and shows that the surface temperature of biaxially drawn PET preforms increases with increasing drawing speeds. Results also show that this effect of drawing speed on the local temperature in the polymer is more pronounced at lower temperatures of stretching, as compared to higher temperatures of stretching.

The observations in Figures 3 and 4 can be explained from the work summarized above. At low strain rates, the material responds to the orientation process. As the strain rate increases, the relaxation process is reduced, and there is more tendency for the material to crystallize, thus lowering the value of the SHP. At high strain rates, internal heating due to friction causes an increase in the local temperature, resulting in more relaxation. Also, as the strain rate increases, the time taken to stretch the specimen to the required extension ratios decreases. There is insufficient time for dissipation of the generated heat, resulting in higher local temperatures. A higher extension ratio is then required for the onset of strain-hardening. A combination of the two phenomena results in the minimum observed in Figure 3. Although the minimum is not seen for uniaxially stretched specimens, for the range of strain rates covered in Figure 3, it could occur at higher strain rates as compared to biaxially stretched specimens. Apparently, the dissipation of the generated heat occurs much faster when specimens are stretched at 100°C as compared to stretching at 90°C, as can be confirmed from previous studies.[25,26] As a result, there is no minimum in the SHP versus extension rate curves, for specimens stretched at 100°C.

A plot of SHP versus 1st-Extension ratio for specimens stretched in the simultaneous biaxial mode at 100°C is shown in Figure 5. Again, the SHP versus 1st-Extension ratio curve is sigmoidal in shape. When compared at the same strain rate, the SHP is highest during stretching in the constrained uniaxial mode, and decreases as the 1st-

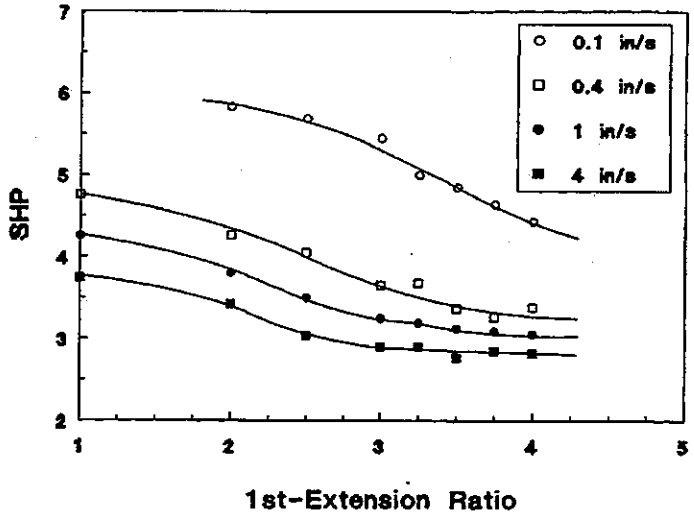


FIGURE 5. SHP vs. the limiting extension ratio in the first stretch direction, for specimens stretched in the biaxial simultaneous mode at 100°C and at different rates of extension.

Extension ratio increases, until it attains a steady value at high limiting extension ratios in the first stretch direction. In the figure, we do not see a value for the SHP for stretching at an extension rate of 0.1 in./s, and to a 1st-Extension ratio of 1.0, because the specimen did not show an upswing in the stress–strain curve in this case. The upswing could probably have been seen if the specimen had been stretched to larger extension ratios than possible on the LET, equipped with the currently fitted stretch head.

We can also compare SHP versus 1st-Extension ratio curves for specimens stretched at various temperatures. Figure 6 shows a plot of SHP versus 1st-Extension ratio, for specimens stretched in the simultaneous biaxial mode at an extension ratio of 1.0 in./s and at various temperatures. At all the temperatures studied, the SHP decreases as the limiting extension ratio in the first stretch direction increases, as was seen at 90 and 100°C. Also, the SHP versus 1st-Extension ratio curve is sigmoidal in shape at all of the temperatures studied. The SHP versus 1st-Extension ratio curves of specimens stretched at lower temperatures lie above those for specimens stretched at higher temperatures, at all values of the 1st-Extension ratio. This means that at any 1st-Extension ratio, the SHP decreases as the temperature of orientation decreases.

THE SHP IN SEQUENTIAL BIAXIAL ORIENTATION

Figure 7 shows a plot of SHP versus 1st-Extension ratio, i.e., the limiting extension ratio achieved in the first stretch direction, for specimens stretched at various strain rates in the sequential biaxial mode at 90°C. The SHP is highest at a 1st-Extension ratio of 1.0, and then decreases steadily as the limiting extension ratio achieved in the first stretch direction increases. The SHP at a 1st-Extension ratio of 1.0 is 4.10 at an extension rate of 0.1 in./s, and is the same as that obtained for simultaneous biaxial orientation because the specimen is stretched in the constrained uniaxial mode in both cases. As the 1st-Extension ratio increases, the SHP decreases until it reaches a value of zero at a critical value of the 1st-Extension ratio. This is because, in the sequential biaxial mode, the stress–strain curve becomes convex upward in shape for specimens stretched to high 1st-Extension ratios. Hence, the SHP cannot be calculated for specimens with high limiting extension ratios allowed in the first stretch direction.

A plot of SHP versus extension rate is shown in Figure 8. Each curve in the figure represents stretching to a particular limiting extension ratio in the first stretch direction. These various limiting extension ratios, or 1st-Extension ratios, are given

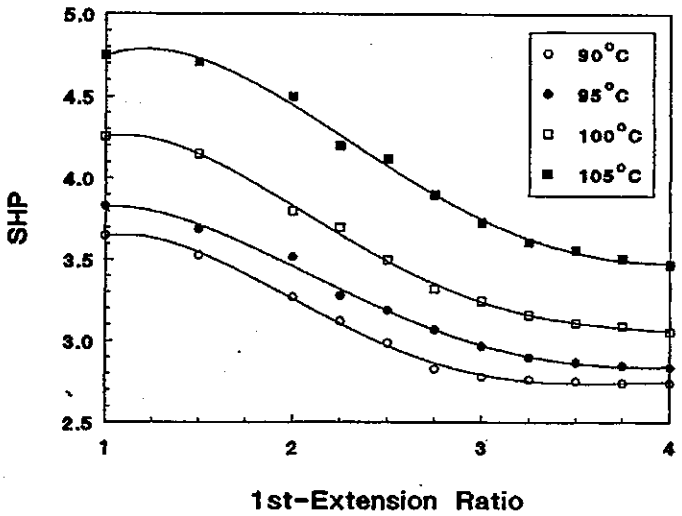


FIGURE 6. SHP vs. the limiting extension ratio in the first stretch direction, for specimens stretched in the biaxial simultaneous mode at an extension rate of 50% per second, and at different temperatures.

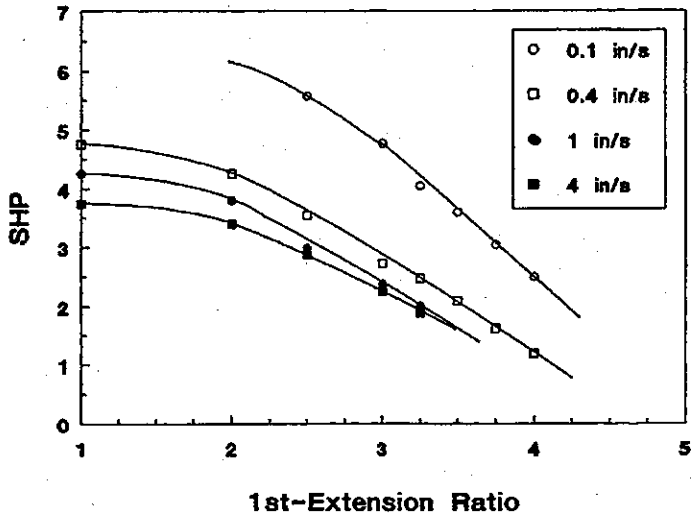


FIGURE 7. SHP vs. the limiting extension ratio in the first stretch direction, for specimens stretched in the biaxial sequential mode at 90°C and at different rates of extension.

in the key to the figure. For specimens stretched at 90°C in the sequential biaxial mode, and to the same limiting extension ratio in the first stretch direction, the SHP is highest at low strain rates. It then decreases steadily over the range of strain rates used, until it attains a constant value at high strain rates. We do not see the minimum in the SHP versus strain rate curve that was observed for specimens stretched in the simultaneous biaxial mode. This is because stretching in the sequential mode involves extension along the first direction and subsequently along the second direction. The time taken to stretch the specimen to the required extension ratios is much longer than that taken in the simultaneous mode. This increased time taken to stretch the specimen results in higher dissipation of the generated heat, and a smaller increase in local temperature. This is the reason for the ab-

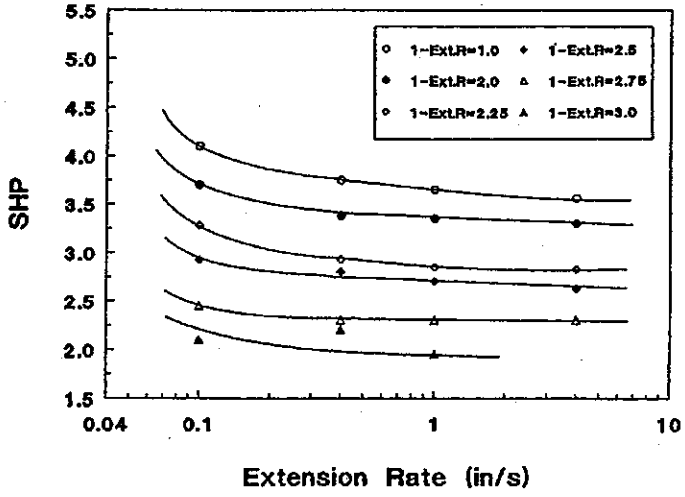


FIGURE 8. SHP vs. extension rate, for specimens stretched in the biaxial sequential mode at 90°C and to different limiting extension ratios in the first stretch direction.

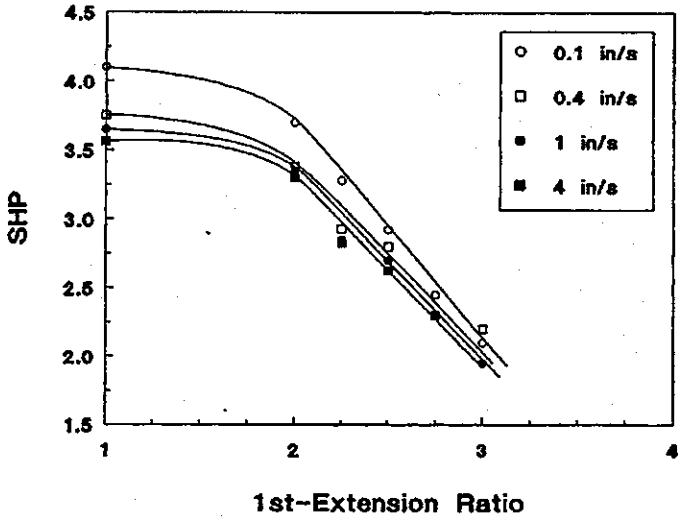


FIGURE 9. SHP vs. the limiting extension ratio in the first stretch direction, for specimens stretched in the biaxial sequential mode at 100°C and at different rates of extension.

sence of the minimum that was seen for specimens stretched in the simultaneous mode.

Figure 9 shows a plot of SHP versus 1st-Extension ratio for specimens stretched in the sequential biaxial mode at 100°C. Again, we see that the SHP is highest at a 1st-Extension ratio of 1.0, and then decreases steadily as the limiting extension ratio allowed in the first stretch direction increases, until it attains a value of zero at a critical value of the 1st-Extension ratio. This critical value of the 1st-Extension ratio decreases as the strain rate increases.

Figure 10 shows SHP versus 1st-Extension ratio plots for specimens stretched in the sequential biaxial mode at an extension rate of 1.0 in./s and at various temperatures. At all the temperatures studied, the SHP decreases as the limiting extension ratio in the first stretch direction increases, as

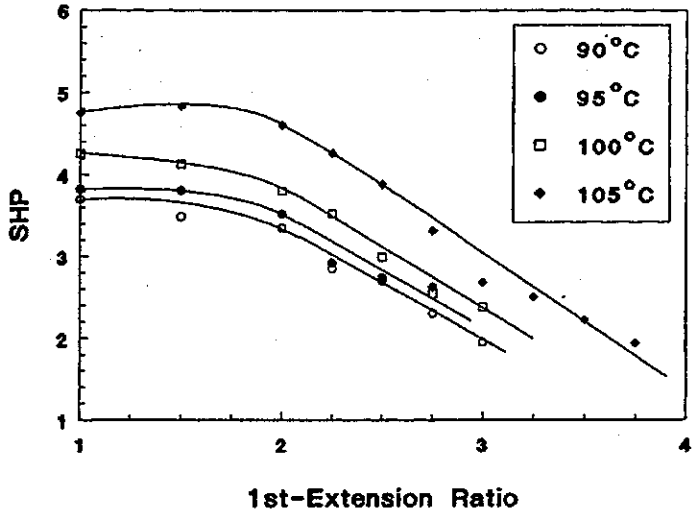


FIGURE 10. SHP vs. the limiting extension ratio in the first stretch direction, for specimens stretched in the biaxial sequential mode at an extension rate of 50% per second, and at different temperatures.

was seen at 90 and 100°C. The SHP versus 1st-Extension ratio curve of specimens stretched at a lower temperature lies above that for specimens stretched at a higher temperature. This means that the SHP decreases as the temperature of orientation decreases. It is also observed that the critical 1st-Extension ratio, at which the value of the SHP is zero in the second stretch direction, decreases as the temperature of orientation decreases.

Now, blow molding of a parison into a container can be performed in either the simultaneous or sequential mode. Simultaneous blowing is achieved by direct blow molding, where the parison is heated and then blown to form the container, while sequential blowing can be done by stretch-blow molding, where the parison is stretched longitudinally, and then blown to form the container. Results from this study have shown that strain-hardening will occur at smaller planar extensions in sequential as compared to simultaneous blowing conditions. Strain-hardening is required in blow molding to give uniformity of wall thickness and properties in the final product. Hence, in sequential blowing, a parison would have to be blown to smaller extension ratios in the hoop and axial directions. Depending on the axial and hoop extension ratios possible, one can then choose the mode by which blow molding would be performed.

SIGNIFICANCE OF THE STRAIN-HARDENING PARAMETER

Previous studies have established that the polymeric material achieves uniformity in thickness and properties at extensions beyond the upswing in the stress–strain curve,[1,3] but have not been lucid in determining the relative position of structural changes with respect to this upswing. There is also uncertainty as to whether alignment of the polymeric chains and the resulting strain-induced crystallization cause strain-hardening, or whether the increased stress level associated with strain-hardening and the upswing in the stress–strain curve are the forces that orient the polymeric chains and cause strain-induced crystallization.

Analyses of the properties of samples prepared to represent various points along the stress–strain curve reveal more about the relationships between the stress–strain curves and changes in properties associated with the different regions of these curves. While the stress–strain curve quantifies the mechanical response of the material to the process of stretching, changes in properties such as density, birefringence, infrared spectrophotometry, x-ray diffraction, mechanical properties, etc., give information about the structural changes occurring within the specimen during stretching. A specimen was stretched in the uniaxial constrained mode at 90°C and at a strain rate of 50% per second. The stress–strain curve recorded during stretching is shown in Figure 11.

For this curve, a strain-hardening parameter of 3.65 was measured. Samples were than prepared by stretching specimens to different extension ratios along the curve, which are shown by vertical arrows on the stress–strain curve. Specifically, the uniaxial extension ratios at which samples were prepared were 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 5.5, and 6.0.

Figure 12 shows a plot of density versus extension ratio for the samples prepared. We see that up to an extension ratio of about 2.5, the increase in density is gradual. The density increases rapidly from an extension ratio of 2.5 to an extension ratio of about 3.5. Beyond an extension ratio of 3.5, the increase in density once again becomes gradual. Superimposing the stress–strain curve on the density curve, as shown in Figure 12, we see that the rapid increase in density occurs much before the upswing in the stress–strain curve. The upswing in the stress–strain curve, in fact, occurs at the extension ratio at which the rapid increase in density ends and the increase once again becomes gradual.

From a plot of birefringence versus extension ratio, shown in Figure 13, we see that birefringence increases gradually at low extension ratios. There is then a rapid increase at an extension ratio of 2.5. This rapid increase continues up to an extension ratio of about 3.5, after which the increase in birefringence again becomes gradual. This trend is seen for all three birefringences measured, namely $(n_2 - n_1)$, $(n_2 - n_3)$, and $(n_1 - n_3)$ where subscripts 1, 2, and 3 denote first stretch direction, second stretch direction, and thickness direction, respectively, in the specimen.

Infrared spectrophotometric analysis was performed on the uniaxially stretched samples. The heights of the peaks at certain wavelengths give information about the intrinsic nature of the material. In our analysis, peaks at wavelengths of 793, 848, 896, and 973 cm^{-1} were studied. A plot of the ratio of the height of the peak at 848 cm^{-1} with the normalizing aromatic peak at 793 cm^{-1} versus the extension ratio is shown in Figure 14. Absorptions

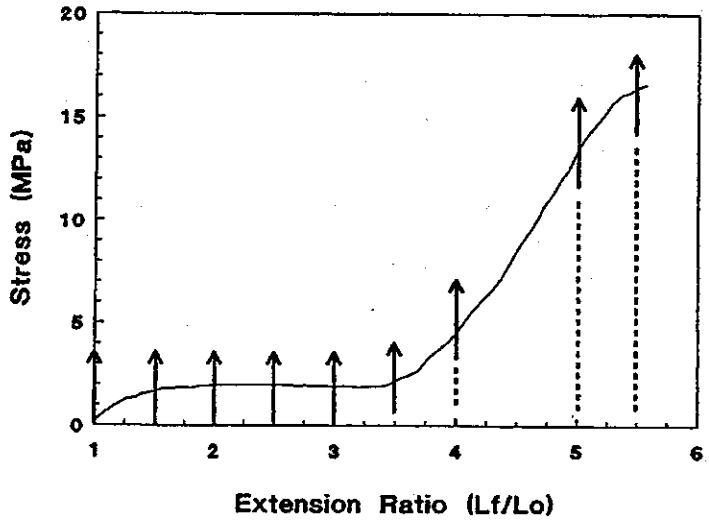


FIGURE 11. Arrows show the extension ratio, and the corresponding points on the stress–strain curve, at which samples were prepared to study the significance of the strain-hardening parameter for a specimen stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

measured in both the stretched and constrained directions show a gradual rise up to an extension ratio of 2.5. There is then a rapid increase in the ratio of the peak heights measured in the stretched direction, up to an extension ratio of about 4.5, after which the rise becomes gradual again. As discussed previously, the ratio of the heights of the peaks at 848 and 793 cm^{-1} gives a measure of the crystallinity in the sample. Further, infrared spectrophotometry measures the crystalline orientation in the sample. Hence, data indicate that there is a steep rise in structural order in the stretched direc-

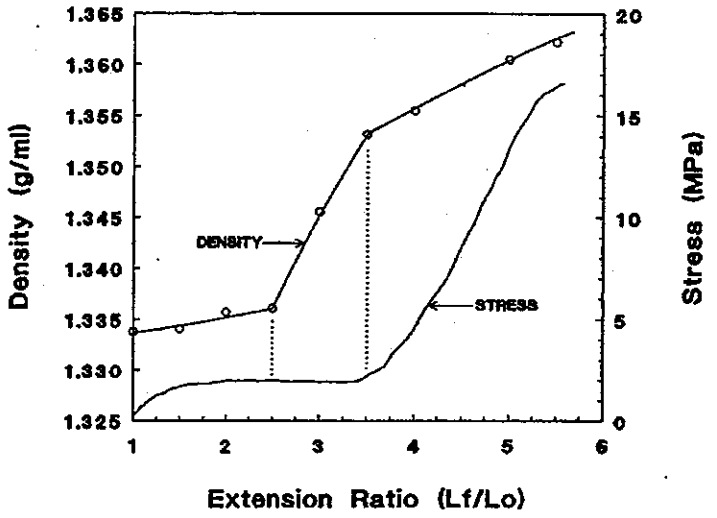


FIGURE 12. Comparison of the density vs. extension ratio curve with the stress measured during stretching, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

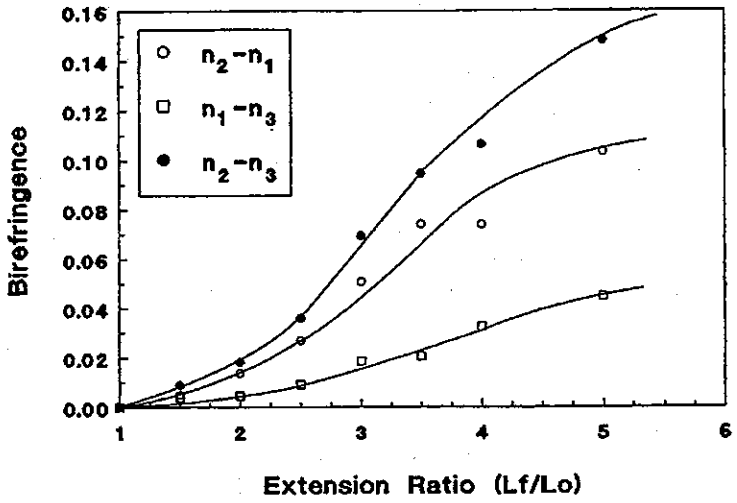


FIGURE 13. Birefringence vs. extension ratio, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second. Subscript 1 indicates the first stretch direction, 2 indicates the second stretch direction, and 3 indicates the thickness direction.

tion, at an extension ratio of 2.5. The amount of crystallinity or structural order in the stretched direction becomes constant beyond extension ratios of 4.5. The increase in the ratio of the peak heights, measured in the constrained direction, remains gradual up to high extension ratios. This indicates that the CH_2 rocking of *trans* ethylene glycol units, in the constrained direction, is unaffected by stretching.

Figure 15 shows a plot of the ratio of the height of the peak at 896 cm^{-1} with the peak at 793 cm^{-1} versus the extension ratio. This ratio gives a measure of amorphous content in the sample. The trend in Figure 15 then shows that the amorphous

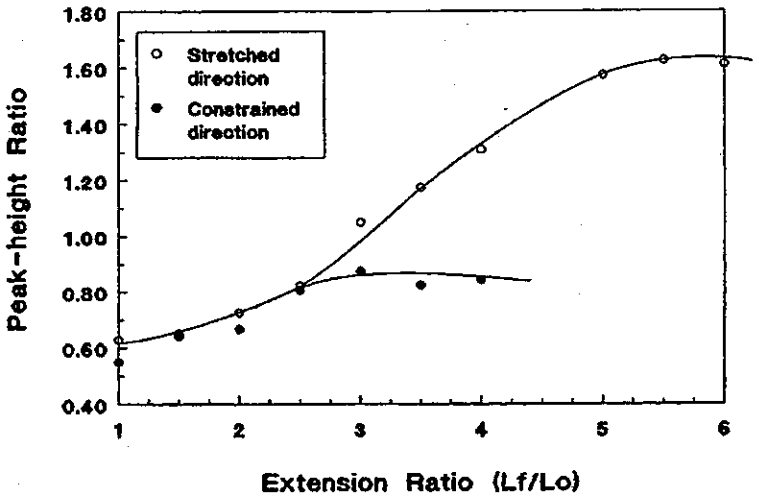


FIGURE 14. Ratio of height of the peak at 848 cm^{-1} with height of the peak at 793 cm^{-1} (from infrared spectrophotometry studies) vs. extension ratio, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

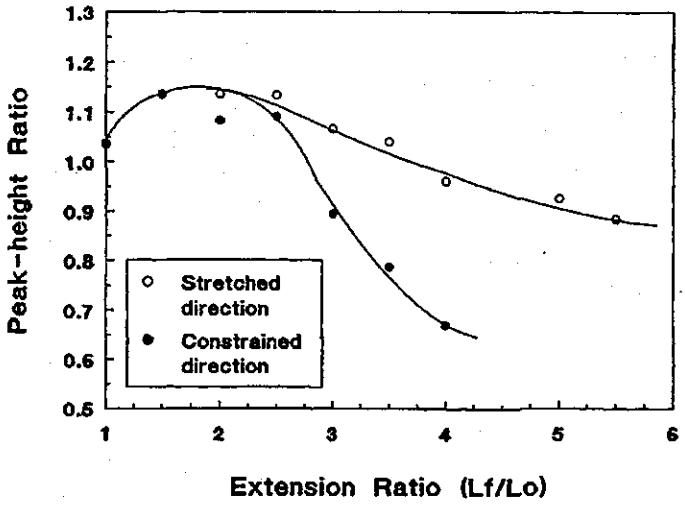


FIGURE 15. Ratio of height of the peak at 896 cm^{-1} with height of the peak at 793 cm^{-1} (from infrared spectrophotometry studies) vs. extension ratio, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

content in the samples decreases gradually in both the stretched and constrained directions, up to an extension ratio of 2.5. There is a steep decrease in the amorphous content in the constrained direction between extension ratios of 2.5 and 4.0, and a leveling off at higher extension ratios. The decrease in amorphous content in the stretched direction remains gradual up to high extension ratios.

The ratio of the height of the peak at 973 cm^{-1} with the peak at 793 cm^{-1} versus the extension ratio is given in Figure 16. As was seen in Figure 14, we again see a gradual rise in the ratio of the peak heights measured in the stretched direction, up to an extension ratio of 2.5, then a rapid increase up to an extension ratio of about 4.0, after which the rise becomes gradual again. Again, this indicates the structural order improves significantly in the stretched direction. The ratio of the peak heights, in the constrained direction, shows a decrease after an extension ratio of 2.5, indicating that the C-O stretch of *trans* ethylene glycol units, in the constrained direction, decreases with stretching.

The above infrared data are based on ratioing specific trans and gauche absorption values with absorption measured for an aromatic reference band present at 793 cm^{-1}. This reference band is known to be independent of conformational changes; however, its intensity may vary as a result of sample orientation, leading to some skewing of the presented data.

Figure 17 shows scans of counts measured per second versus 2θ, recorded during x-ray diffraction analysis. Scans recorded for samples stretched to various extension ratios are shown. When the specimen is amorphous, the scan does not show a peak. Instead, a typical amorphous hump is observed, with a maximum at a 2θ of about 21°. At high extension ratios, the specimen is semi-crystalline as a result of strain-induced crystallization, and exhibits a peak in the scan at a 2θ of about 26°. Scans of samples stretched to extension ratios of 1.0 and 2.0, namely curves 1 and 2 in the figure, show the diffuse amorphous hump. A scan of a sample stretched to an extension ratio of 3.0 shows the semi-crystalline peak. This semi-crystalline peak becomes sharper with increasing extension ratio. We see the transition from the diffuse amorphous hump to the semi-crystalline peak at an extension ratio of 2.5. The peak obtained is due to the formation of repetitive structural units in the sample. Hence, the x-ray diffraction scans suggest that structural ordering begins at an extension ratio of 2.5.

The width of the peak, at half of the peak height, can be measured. The reciprocal of the peak width at half peak height gives a relative measure of the mean dimension of the crystallites in the polymer.[27] A plot of peak width at half peak

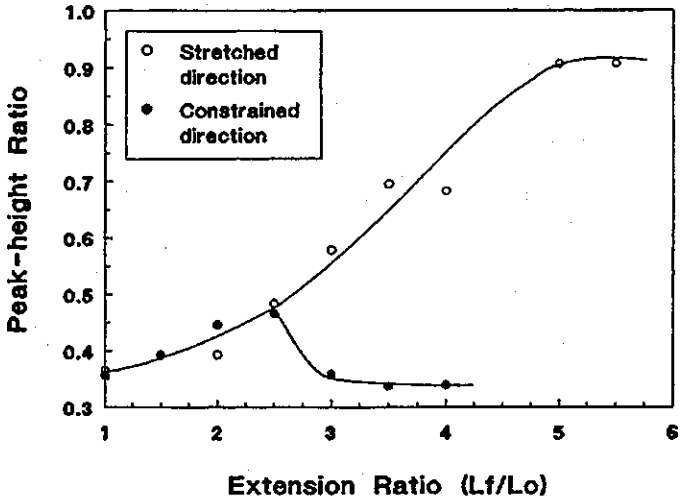


FIGURE 16. Ratio of height of the peak at 973 cm^{-1} with height of the peak at 793 cm^{-1} (from infrared spectrophotometry studies) vs. extension ratio, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

height versus extension ratio for the samples is shown in Figure 18. True comparison of the peak widths cannot be made because the amorphous samples showed a maximum at a 2θ of about 21° while semi-crystalline samples showed a peak at a 2θ of about 26°. A comparison of the values of peak width at half peak height has been made purely to show that the trend obtained in the study of other properties also holds true for x-ray diffraction analysis. Figure 18 shows that the reciprocal of the peak width at half peak height increases gradually up to an extension ratio of 2.5. There is then a rapid increase from an extension ratio of 2.5 to an extension ratio of about 3.5, after which the in-

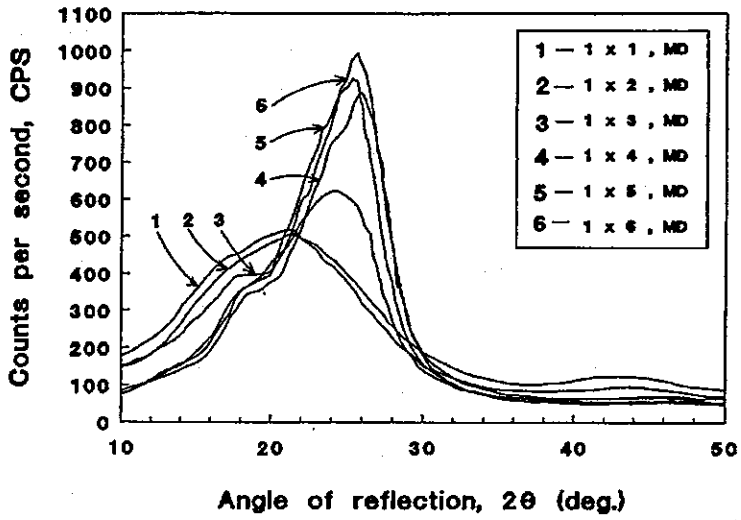


FIGURE 17. Scans of counts measured per second (from x-ray diffraction studies) vs. angle of reflection, 2θ, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

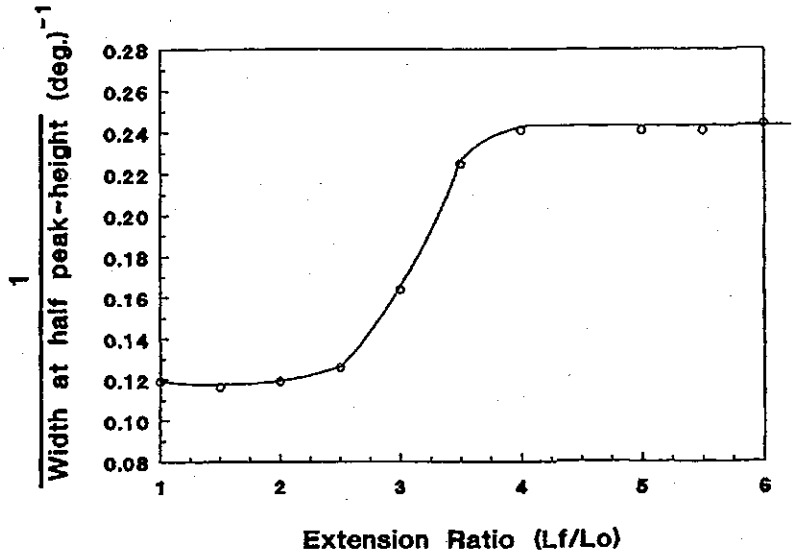


FIGURE 18. Peak width at half peak height (from x-ray diffraction studies) vs. extension ratio, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

crease again becomes gradual at higher extension ratios. This means that the size of the crystallites increases rapidly from an extension ratio of about 2.5 to an extension ratio of about 3.5. Increase in the size of the crystallites becomes gradual beyond extension ratios of about 3.5, indicating that most of the strain-induced crystallization occurs between extension ratios of about 2.5 and 3.5.

A plot of the counts measured per second at the peaks versus the extension ratio is shown in Figure 19. Again, true comparison between the counts

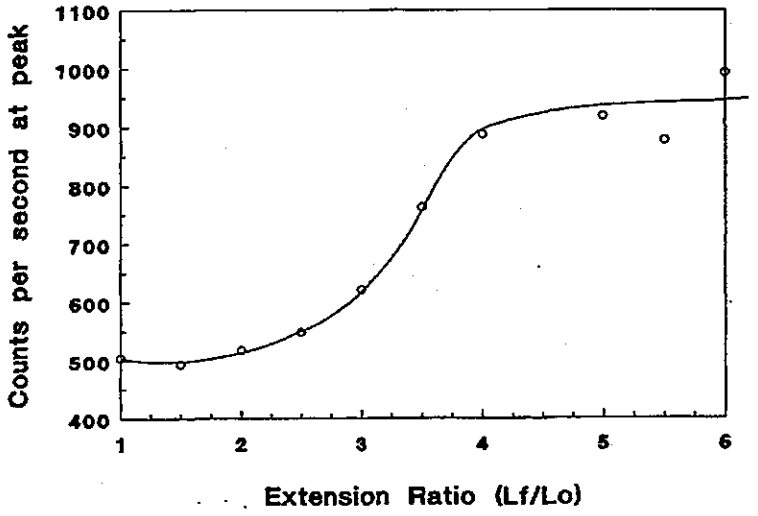


FIGURE 19. Peak height in counts measured per second (from x-ray diffraction studies) vs. extension ratio, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

measured from essentially amorphous and semicrystalline samples cannot be made because the peaks occur at different values of 2θ. From the figure, we see that the counts measured per second are almost constant up to an extension ratio of 2.5, where there is an increase in the counts measured. This increase persists up to an extension ratio of 4.0 before leveling off. The counts measured per second from the x-ray diffraction scans give measures of the relative amounts of crystallinity in the samples. Figure 19 then indicates that the crystallinity is very small in samples stretched up to an extension ratio of 2.5. The magnitude of the crystallinity then increases between extension ratios of 2.5 and 4.0, before attaining an almost constant value. The amount of crystallinity increases negligibly beyond an extension ratio of 4.0. This is consistent with results obtained previously.

Figure 20 shows a plot of yield stresses, measured in the stretched and constrained directions of the samples, versus the extension ratio. The yield stress in the stretch direction is almost constant up to an extension ratio of about 2.5. It then increases with increasing extension ratio. This increase in the property at an extension ratio of 2.5 agrees with trends obtained from the study of density, birefringence, infrared dichroism, and x-ray diffraction. Further, as was observed for other properties, there is little change in the yield stress measured in the constrained direction, with extension. Other mechanical properties such as ultimate stress and modulus also show similar trends.

TRUE STRESS VERSUS EXTENSION RATIO

Instead of the engineering stress, the true stress during stretching can be calculated. A comparison can be made between the extension ratio at which the upswing occurs in the true stress versus extension curve, and the extension ratio at which the rapid increase in properties is observed.

From the plot of density versus extension ratio, we can calculate the change in volume of the sample upon stretching to a particular extension ratio. Conservation of mass implies that:

$$\rho_f = \rho_0 \frac{L_{1,0}\, L_{2,0}\, t_0}{L_{1,f}\, L_{2,f}\, t_f}$$

where: ρ_f is the density of the sample at a particular extension ratio; ρ_0 is the initial density of the unstretched specimen; $L_{1,f}$ is the length of the sample in the first stretch direction, the constrained direction, at that particular extension ratio; $L_{2,f}$ is the length of the sample in the second stretch direction, the stretched direction, at that particular extension ratio; $L_{1,0}$ is the initial length of the unstretched specimen in the first stretch direction; $L_{2,0}$ is the initial length of the unstretched specimen in the second stretch direction; and t_0 and t_f are initial and final thicknesses, respectively.

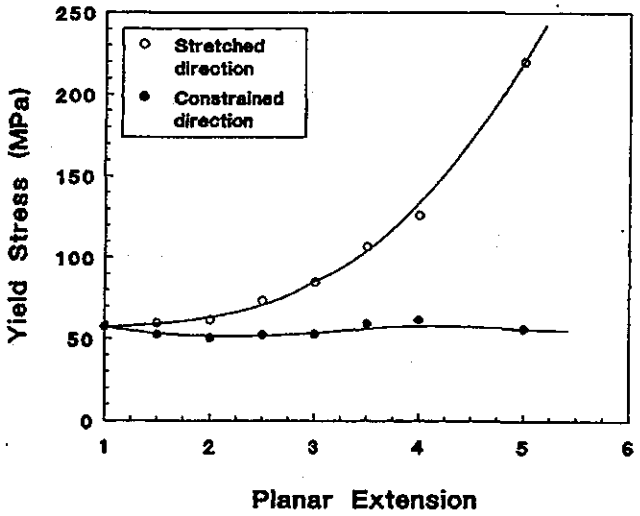


FIGURE 20. Yield stress vs. extension ratio, for samples stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

Now, engineering stress while stretching uniaxially in the second direction is calculated by the formula:

$$\sigma_e = \frac{\text{Load}}{L_{1,0}\, t_0}$$

where the "Load" is measured from the LET while stretching the sample, σ_e is the engineering stress calculated as given above, and the true stress is calculated by the formula:

$$\sigma_t = \frac{\text{Load}}{L_{1,f}\, t_f}$$

where σ_t is the true stress calculated as given above.
But

$$t_f = \frac{L_{1,0}\, L_{2,0}\, t_0}{L_{1,f}\, L_{2,f}} \times \frac{\rho_0}{\rho_f}$$

Hence,

$$\sigma_t = \frac{\text{Load}}{L_{1,0}\, t_0} \times \frac{\rho_0}{\rho_f} \times \alpha_2$$

where α_2 is the extension ratio in the second stretch direction, i.e., the direction of stretching. Hence,

$$\sigma_t = \sigma_e \times \frac{\rho_0}{\rho_f} \times \alpha_2$$

Thus, knowing the density of the sample at any given extension ratio, true stress (taking into account the change in volume) can be calculated, from the engineering stress measured at the extension ratio.

Figure 21 shows a plot of the true stress, calculated as explained above, versus the extension ratio. The true stress versus extension curve is very similar to the engineering stress versus extension curve, and shows a plateau region up to an extension ratio of about 3.65, where there is an upswing in the curve. The engineering stress versus extension curve also showed the upswing at an extension ratio of 3.65. Hence, the true stress curve does not supply any further information other than what was learned from the engineering stress versus extension curve.

Conclusions

For specimens stretched in the simultaneous biaxial mode, we see that:

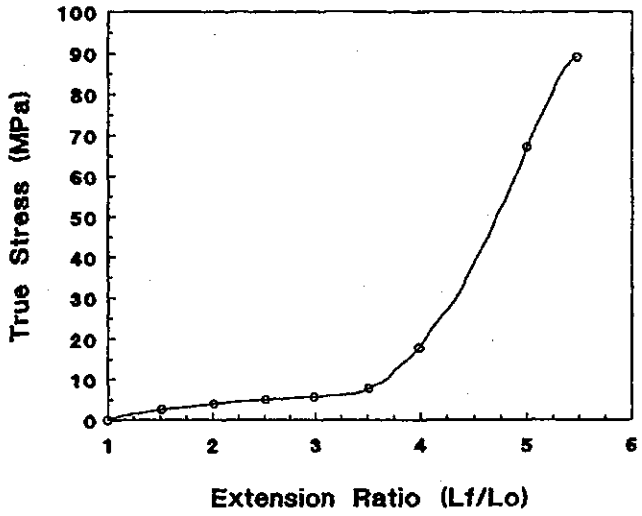


FIGURE 21. True stress (accounting for changes in volume during stretching) vs. extension ratio, for sample stretched in the uniaxial constrained mode at 90°C and 50% strain per second.

- The strain-hardening parameter, SHP, versus 1st-Extension ratio curve is sigmoidal in shape, for specimens stretched at the same strain rate. There is a critical 1st-Extension ratio, at any strain rate, beyond which the SHP has a constant value.
- The value of the strain-hardening parameter, SHP, decreases as: (a) the strain rate at which the specimens are stretched increases; (b) the limiting extension ratio allowed in the first stretch direction increases; and (c) the temperature of stretching decreases.
- The SHP versus extension rate curve is concave upward in shape. For specimens stretched at 90°C, the SHP decreases as the strain rate increases. It reaches a minimum value before increasing at higher strain rates. This minimum is caused by increased relaxation and delayed strain-hardening, due to an increase in the local temperature, during stretching at a higher strain rate.

For specimens stretched in the sequential biaxial mode, we see that:

- The value of the strain-hardening parameter, SHP, decreases as: (a) the strain rate at which the specimens are stretched increases; (b) the limiting extension ratio allowed in the first stretch direction increases; and (c) the temperature of stretching decreases.
- In the plot of SHP versus 1st-Extension ratio, for specimens stretched at the same strain rate, there is a critical 1st-Extension ratio at which the SHP attains a value of zero. Strain-hardening then occurs in the first stretch direction at values of 1st-Extension ratio greater than this critical 1st-Extension ratio.

A study of changes in mechanical and optical properties during stretching shows that:

- The upswing in the engineering stress and true stress curves occurs much later than the steep increase in properties. This steep increase in properties indicates strain-induced crystallization due to structural ordering within the polymer.
- The upswing in the stress versus extension curves occurs at the extension ratio that indicates completion of most of the strain-induced crystallization, where the steep increase in properties ends and the increase becomes gradual again. This means that the onset of strain-hardening occurs upon the completion of most of the strain-induced crystallization.

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Effect of strain rate and temperature on stress-strain properties of EVA-LDPE blends and the mechanism of strain hardening

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SUMMARY:

Stress-strain behaviour of different blends of poly(ethylene-co-vinyl acetate) (EVA) (28 wt.-% VA content) and low density polyethylene (LDPE) is studied under various strain rates and temperatures. It is found that stress-strain plots of such semicrystalline polymer blends consist of three parts, namely, elastic or Hookeian region, region of chain slippage and region of strain hardening. Decrease in strain rate has an increasing effect on the strain hardening region. Increase in measurement temperature adversely affects the whole stress-strain plot. It is apparent from the study that at an elevated temperature the process of strain hardening is dependent on the crystalline melting point of the major component in the blend. The X-ray and DSC studies reveal that the process of strain hardening is mainly due to a change in internal order of crystallites in LDPE and LDPE-rich blends, whereas in EVA and EVA-rich blends it is due to induced crystallization in the amorphous phase.

ZUSAMMENFASSUNG:

Das Zug-Dehnungs-Verhalten von verschiedenen Blends aus Poly(ethylen-co-vinylacetat) (EVA, 28 wt.-% VA-Anteil) und Polyethylen (LDPE) wurde bei unterschiedlichen Dehnungsgeschwindigkeiten und Temperaturen untersucht. Die Zug-Dehnungs-Kurven solcher semikristalliner Polymerblends bestehen aus drei Teilen — elastischer oder Hookescher Bereich, Bereich des Aneinanderabgleitens der Ketten sowie Dehnungshärtungsbereich. Eine Verminderung der Dehnungsgeschwindigkeit bewirkt eine Vergrößerung des Dehnungshärtungsbereiches. Die Erhöhung der Meßtemperatur beeinflußt die gesamte Zug-Dehnungs-Kurve. Aus der Untersuchung geht hervor, daß der Prozeß der Dehnungshärtung bei erhöhten Temperaturen vom Kristallschmelzpunkt der Hauptkomponente des Blends abhängt. Röntgen- und DSC-Untersuchun-

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gen zeigen, daß die Dehnungshärtung von einer Veränderung der Kristallitstruktur in LDPE und LDPE-reichen Blends ausgeht, während sie in EVA und EVA-reichen Blends auf eine induzierte Kristallisation in der amorphen Phase zurückzuführen ist.

Introduction

The two-phase polymer system derived from blends of crystalline polymers having varying degree of crystallinity can form a tough engineering material having good stiffness, elasticity, impact strength, tensile strength, and toughness. These materials possess several mechanisms for deformation which can dissipate strain energy and account for various properties of the system.

The properties of semicrystalline materials can be greatly modified during drawing, which can be realized from the stress-strain characteristics of these materials[1–11]. The semicrystalline polymers exhibit the tendency of strain-induced crystallization during drawing and it accounts for appreciable increase in strength for highly oriented polymers like fibres. The theory of induced crystallization is a subject of interest for many workers[12,13].

The present investigation embodies the effect of strain rate and temperature on stress-strain behaviour of different EVA-LDPE blends. An effort is made to understand the mechanism of strain hardening of these systems through thermal and X-ray analysis.

Experimental

Materials

The materials used in the investigation and their characteristics are given in Tab. 1.

Preparation of the blends and test samples

The EVA-LDPE blends are designated as P_0, P_{30}, P_{40}, P_{50}, P_{60}, P_{70} and P_{100}, where the subscript denotes the weight percent of LDPE in the blend. The blending was carried out in a Brabender Plasticorder PLE 330, using a cam type rotor. The mixer chamber temperature was set at 130 °C with a rotor speed of 60 r.p.m. During blending, LDPE was first allowed to melt in the plasticorder at the set temperature for 4–5 min. EVA was then added to the molten LDPE, and blending was continued till

the mixing torque value attained a steady state. The time to attain this steady state value for torque was found to vary in between 4–5 min depending on the blend composition. The hot mass was then taken out from the mixer and sheeted out in a two roll mill set at 2 mm nip gap. The material sheeted out was remixed in the plasticorder for further 2 min to obtain better dispersion and intimate mixing. The blend was finally sheeted out in the mill, and subjected to compression moulding in a Labo press at a temperature of 170 °C for 4 min under a pressure of 100 ± 5 kg/cm^2. Samples for tensile testing were punched out from the moulded sheets.

Tab. 1. Materials used in the investigation.

	Trade name	Characteristics	Producer
EVA copolymer	PILENE 2806	28 wt.-% vinyl acetate content MFI = 6 g/10 min d = 0.95 g/cm^3	PIL, India
LDPE	INDOTHENE 20CA002	MFI = 0.20 g/10 min d = 0.92 g/cm^3	IPCL, India

Measurement of mechanical properties

Tensile testing of the samples was carried out at room temperature (25 °C), 50 °C, 70 °C, and 80 °C according to ASTM D412-80 test method in a Zwick Universal Testing Machine (Model UTM-1445). The cross-head speed for measurements at 50 °C, 70 °C, and 80 °C temperature was set at 20 cm/min and four different crosshead speeds such as 10, 20, 50, and 100 cm/min for measurements at room temperature (25 °C).

Differential scanning calorimetry (DSC)

DSC analyses of different strained and unstrained blend compositions were carried out using a Stanton Redcroft STA 625 thermal analyzer, with a heating rate of 10 °C/min. The tensile test pieces were preserved after tensile failure. Then, at a distance of 1 cm from torn end, the samples were cut and collected for DSC studies (Fig. 1). These are referred to as "strained" samples. These samples were subjected to DSC studies and compared with the results of unstrained samples to check the change in the degree of crystallinity.

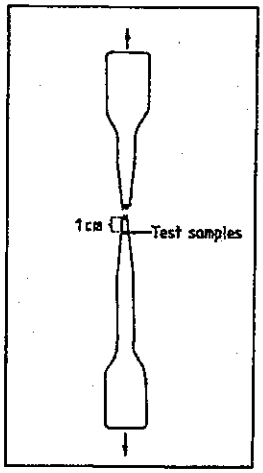


Fig. 1. Schematic representation of sampling from torn end of tensile specimen for DSC and X-ray study.

X-ray studies

To determine the degree of crystallinity of strained and unstrained blend compositions, X-ray diffraction patterns (intensity, I, vs. twice the angle of diffraction, $2\theta_B$, where θ_B is the Bragg angle) of the samples were recorded with a Philips X-ray diffractometer PW 1840 using Ni-filtered CuK_α radiation (Fig. 2).

From the X-ray diffraction patterns, the degree of crystallinity can be measured easily from the relative integrated intensities corresponding to the crystalline and amorphous phases[14–17].

Results and discussion

Effect of composition

In a semi-crystalline polymer, the amorphous regions provide a significant part of the total load-bearing strength of the bulk polymer. The viscoelastic load-bearing strength is largely dependent on the degree of orientation in this amorphous region[18].

The typical stress-strain curves of such polymers can be schematically subdivided into three parts (Fig. 3). Part I: Hookeian region; part II: the stress-

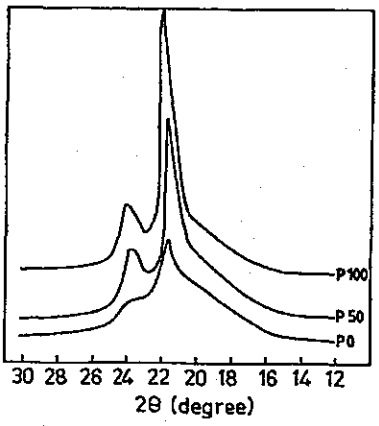


Fig. 2a.

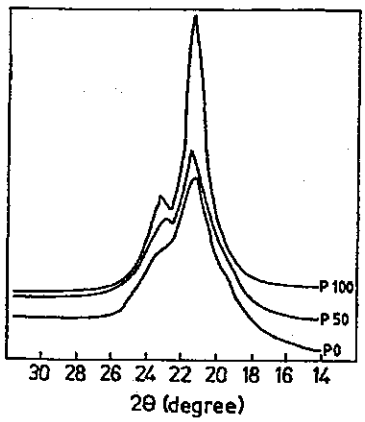


Fig. 2b.

Fig. 2. X-ray diffraction patterns for pure EVA (P_0), LDPE (P_{100}), and 50:50 EVA/LDPE blend (P_{50}); (a) unstrained samples and (b) strained samples.

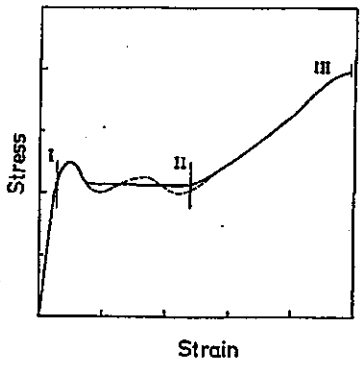


Fig. 3. Representative stress-strain curve of a semicrystalline polymer; I, II, III: see text.

strain curve in this region could be either fairly flat (solid line) or uneven with a few ups and downs, generally known as region of stress softening (dashed line); part III: this part of the curve may be identified as the well-known strain hardening region where stress increases at fast rate with the increase of strain till the ultimate failure. At this stage, molecular segments of both amorphous and crystalline components get oriented in a more orderly manner along the drawing direction.

The stress-strain curves of different blend compositions and pure components are presented in Fig. 4. The composition has a marked effect on the

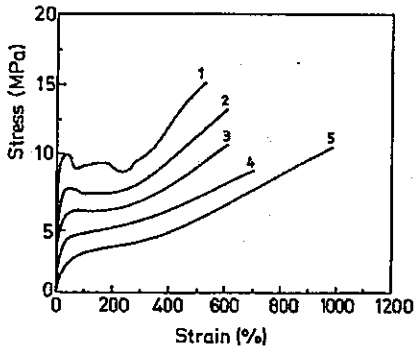


Fig. 4. Stress-strain plots of LDPE, EVA, and their blends (1) 100/0, (2) 70/30, (3) 50/50, (4) 30/70, (5) 0/100 (LDPE/EVA) (strain-rate: 50 cm/min).

nature of stress-strain curve. Three different regions of stress-strain curves describing different molecular phenomena can be distinctly identified for pure LDPE and LDPE-rich blends, e.g. P_{70} and to some extent even for P_{50} blend. These compositions exhibit well-defined yield point and stress softening effect on stress-strain curves, whereas those for pure EVA (P_0) and EVA-rich blend, e.g. P_{30}, do not exhibit any well-defined yield point. Moreover, for EVA-rich blends, the exact initiation and termination of different regions on stress-strain curves as described earlier are difficult to mark, especially regions II and III are overlapping. This means that the chain slippage and orientation of chains along the drawing direction take place simultaneously. The tensile strength, elongation at break, high strain modulus, and Young's modulus are all composition dependent.

The elastic deformation which is due to intermolecular force of attraction can be estimated in terms of Young's modulus. Young's modulus of a semi-crystalline polymer is determined by the proportion of taut tie molecules, that is, extended chains which produce links between two crystalline blocks or between crystalline blocks and coiled amorphous zones. In other words, the individual molecules extending from one crystallite to another pass through the amorphous regions and thereby yield the restoring elastic forces[19]. Young's modulus (Y) increases with the increase of LDPE content of the blend. However, a good linear plot is obtained when Young's modulus is plotted against the degree of crystallinity of different composition (Fig. 5). The modulus at 300% elongation and the tensile strength increase with the

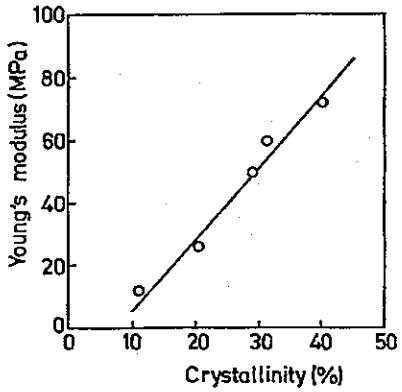


Fig. 5. Plot showing crystallinity of different LDPE/EVA compositions vs. Young's modulus; for data see Tab. 3.

increase in PE concentration in the blend (Tab. 2). However, the elongation at break generally increases with the increase in EVA concentration in the blend. But these variations of strength properties are very much dependent on the strain rate. The trend of variation of different properties observed at higher strain rates like 100 cm/min or 50 cm/min change significantly when strain rate is reduced to 20 cm/min or 10 cm/min.

Tab. 2. Mechanical properties of the blends.

Blend	Tensile strength (MPa)	Elongation at break (%)	Modulus at 300% strain (MPa)	Young's modulus (MPa)	Yield stress (MPa)	Crystallinity (%)
P_0	10.5	990	3.8	12	3.0	12.5
P_{30}	8.8	710	5.2	26	4.4	21.0
P_{50}	11.2	653	6.6	50	6.0	28.0
P_{70}	13.0	610	7.6	60	7.6	32.5
P_{100}	15.0	635	9.6	72	9.9	40.2

Effect of strain rate

The strain rate has a marked effect on the nature of stress-strain curves of different blend compositions. The stress-strain plots of P_{100}, P_{50}, and P_0 at

four different strain rates are presented in Fig. 6. It is found that the strain rate has maximum influence on strain hardening region of stress-strain plots for all compositions, whereas marginal effects are encountered on region I (elastic deformation) and region II (chain slippage).

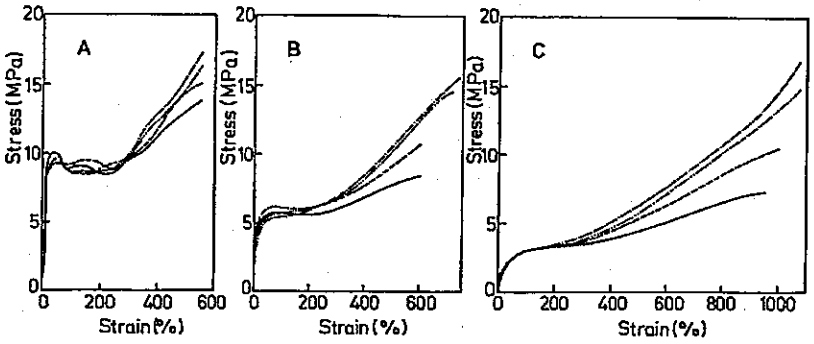


Fig. 6. Effect of strain rate on stress-strain properties of A) LDPE (P_{100}), B) LDPE/EVA 50:50 (P_{50}), and C) EVA (P_0); strain rates: (–·–·–) 10 cm/min, (–···–···) 20 cm/min, (– – – –) 50 cm/min, (———) 100 cm/min.

Thus, Young's modulus and yield stress are marginally changed with the change in strain rate, whereas appreciable increase in tensile strength and elongation at break are observed for all blends when the strain rate is gradually decreased from 100 cm/min to 10 cm/min. This reveals that the lowering of strain rate favourably affects the chain orientation in the amorphous region as well as orientation of crystallites along the drawing direction. However, the effect of strain rate is more pronounced in pure EVA and EVA-rich blends compared to that in pure PE or PE-rich blends. This reflects that the effect of strain hardening will be more pronounced for the composition with lower crystalline content.

Strain hardening and strain-induced crystallization

As discussed earlier, during strain hardening both amorphous and lamella components attempt to orient along the drawing direction. These orientations

during drawing lead to close packing of chains and thereby cause appreciable increase in the intermolecular forces of attraction which accounts for high stress at rupture.

To understand the contribution of two different types of orientation to the degree of strain hardening, thermal and X-ray analysis of drawn and undrawn samples of pure and blend compositions were investigated. Fig. 7 shows the DSC thermogram of crystalline melting.

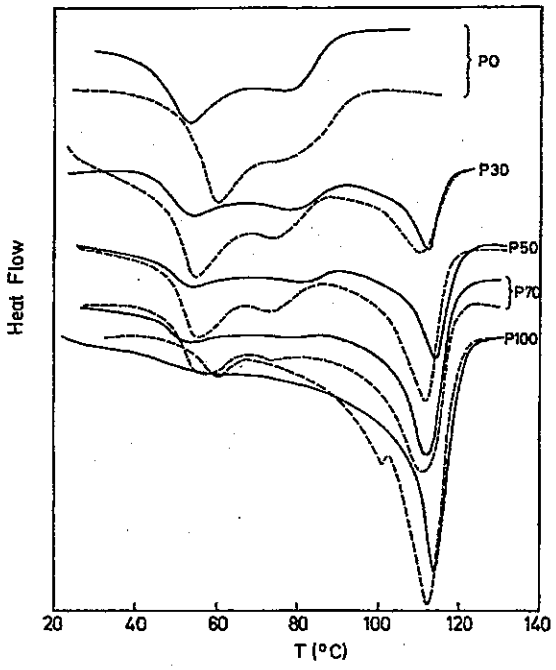


Fig. 7. Comparative DSC thermograms of LDPE, EVA, and their blends in (———) unstrained and (– – –) strained (at 20 cm/min rate) conditions.

Thermal analysis (DSC) was used to investigate the different types of ordering of molecular chains. Due to stretching, the semi-crystalline polymer undergoes plastic deformation leading to high orientation of chains in the amorphous regions as well as reorganization of crystallite structure in the drawing direction. Due to stretching, a part of the chains in the amorphous

zone may be oriented in a perfectly crystalline fashion which may increase the crystallinity content. Some other part of the chains in the amorphous zone may attain some kind of ordered arrangement where ordering is intermediate between that of crystalline and amorphous phases[19]. This intermediate state may not be assessed by x-ray. Due to stretching, crystallite internal order changes by breaking the originally present spherulitic order. All these factors contribute to the melting enthalpy, ΔH. The heat of fusion (ΔH) is proportional to the area of melting endotherm. The broad range of melting for EVA indicates that there are different types of crystals which start melting over a wide temperature range. The fractional crystallinity, x_c, of different compositions from DSC study was calculated (Tab. 3) assuming a heat of fusion for 100% crystalline PE as 290 J/g[20,21].

Tab. 3. Crystallinity of strained and unstrained blends obtained from DSC and X-ray studies (strain rate = 20 cm/min).

Blend	Condition	ΔH^a (J/g)	Crystallinity[a] (%)	Crystallinity[b] (%)
P_0	Unstrained	28.1	9.7	12.5
	Strained	42.3	14.6	21.0
P_{30}	Unstrained	38.6	13.0	21.0
	Strained	57.4	19.8	28.0
P_{50}	Unstrained	37.7	13.5	28.0
	Strained	66.3	22.8	29.1
P_{70}	Unstrained	50.7	17.5	32.5
	Strained	63.4	21.9	36.9
P_{100}	Unstrained	76.2	26.3	40.2
	Strained	100.9	34.8	44.3

[a] From DSC measurements.
[b] From X-ray studies.

The increase in heat of fusion from undrawn to drawn samples of one pure component are not the same as that of the other. For LDPE the increase in ΔH is about 30%, but for EVA it is about 50%. However, it is worth mentioning here that for both the pure components there are distinct changes in the nature of thermogram, especially in the width of the melting peak and creation of a new peak in drawn PE sample. A broad melting temperature range reduces to a sharp low temperature peak for EVA on drawing. However, the increase in the melting peak height and area for both the pure components is observed on

drawing. These thermograms get further modified in blends and change with blend composition. The detailed discussion on the change in thermograms and X-ray diffraction patterns for different blends due to straining will be communicated in future.

The degree of crystallinity, x_c, of different unstrained and strained samples as measured by the X-ray diffraction technique as well as by DSC are given in Tab. 3. It is observed that the nature of variation of x_c determined by both the techniques is similar, though there is a difference in the absolute values. Similar lower absolute values of crystallinity from DSC as compared to X-ray have also been reported earlier[20,21]. It is well-known that absolute values of crystallinity may vary depending on the techniques of measurement. However, the difference between crystallinity obtained from DSC and X-ray technique could have been accounted for through consideration of azimuthal diffraction intensity. This measurement could not be done due to inadequacies of experimental facilities. The change in crystallinity due to drawing measured in terms of X-ray technique is significantly less than what is expected from the degree of strain hardening and enthalpy measurement, especially for PE and PE-rich blends like P_{70} and P_{50}. However, there is significant increase in the degree of crystallinity for EVA and EVA-rich blends on stretching, as observed from X-ray data.

So, it may be concluded that during strain hardening, there is not much increase in the strain-induced crystallinity of the amorphous zone of PE. It was suggested that in PE, due to stretching break up of crystal occurs followed by rapid recrystallization along the direction of stretching[3]. That is, the isotropic lamellar texture is broken up and reformed as a fibrillar structure containing aligned crystal blocks. Thus, there is a change in the internal order of crystallites without significant change in crystallinity. The increase in ΔH may be argued as mainly due to the change in crystallite internal order as well as high ordering (parallel alignment) of chains in the amorphous region leading to an "intermediate state" as discussed earlier (Fig. 8).

However, for EVA and EVA-rich blends where amorphous content is much higher, during strain hardening the chains can be manipulated and organized in a fashion similar to those found in crystals, as a result some increase in crystallinity is observed by both X-ray and DSC analysis. It was reported earlier[4] that high degree of drawing may disintegrate the long range ordered arrangement of crystallites like spherulites. On extensive stretching, the spherulites become indistinctive in shape and the material becomes anisotropic (Fig. 9). This accounts for some increase in enthalpy with marginal increase in crystallinity derived from X-ray studies in LDPE. It is also

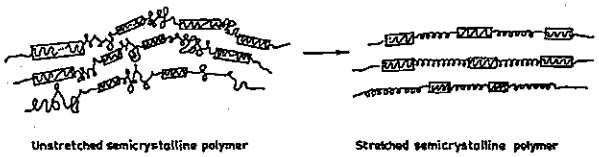


Fig. 8. Schematic representation of unstrained and strained semicrystalline polymer chains.

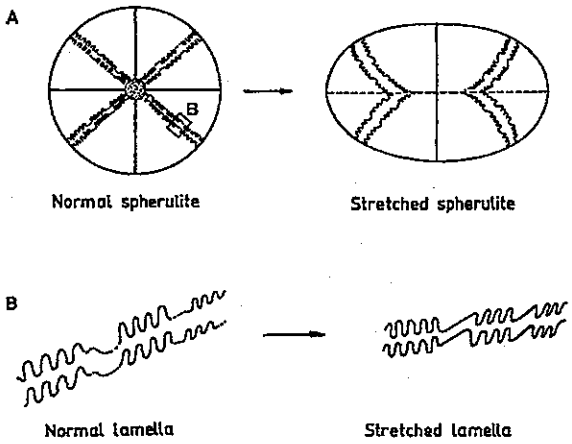


Fig. 9. Change in the crystalline zone of a semicrystalline polymer under stress; A) spherulites having long order crystallinity and B) lamella structures constituting the spherulites.

important to mention here that the conformational change as estimated for samples collected from torn end can be linked with the permanent structural change which might be somewhat different from the exact change incurred during testing since some chain relaxation after failure occurs.

Effect of temperature

The development of modulus-temperature relationships as a characterization tool has been due in large part to Tobolsky and his co-workers[22]. The temperature-dependent stress-strain behaviour of different systems is given in

Fig. 10–12. The increased temperature reduces the stiffness of the polymer as observed from the continuous decrease of Young's modulus with the increase in the measurement temperature. The increase in measurement temperature also reduces the yield stress, tensile strength, high strain modulus (at 100% elongation), and elongation at break, for all compositions.

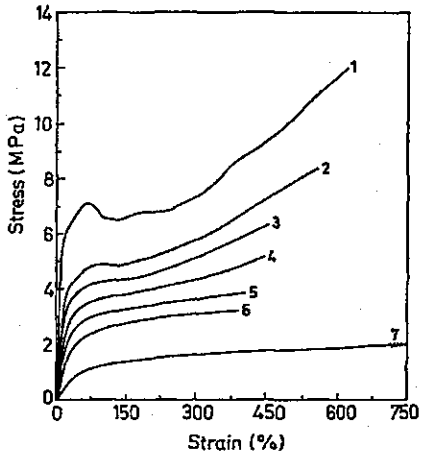


Fig. 10. Stress-strain plots of LDPE, EVA, and their blends at 50 °C; (1) 100/0, (2) 70/30, (3) 60/40, (4) 50/50, (5) 40/60, (6) 30/70, (7) 0/100 (LDPE/EVA).

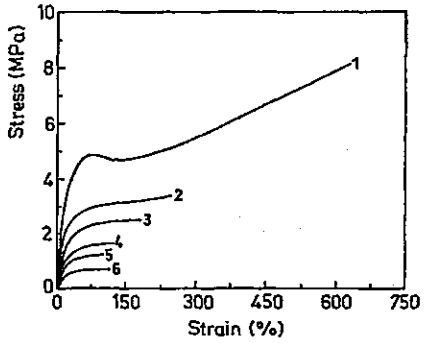


Fig. 11. Stress-strain plots of different LDPE/EVA blends and LDPE at 70 °C, blend compositions see Fig. 10.

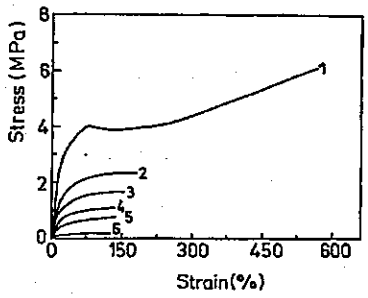


Fig. 12. Stress-strain plots of different LDPE/EVA blends and LDPE at 80 °C, blend composition see Fig. 10.

It is found that the increase in temperature adversely affects the process of strain hardening. The effect is much more significant for EVA-rich blends compared to that in LDPE-rich ones. In crystalline polymers, the crystallites act as the crosslinking sites, preventing the free flow of the molecules under stress[23]. But at a much higher temperature near crystalline melting point, these physical crosslinks cease to act. The uncrosslinked polymer will flow in a viscous manner as whole molecules begin to undergo translational motion. The process of strain hardening involves the segmental motions of polymer chain but not that of the whole molecules. As long as the crystallites are present in the system, this ordered arrangement of molecular segments during strain hardening is possible. So the process of strain hardening proceeds even up to 80 °C (the maximum measurement temperature) for pure PE where crystallites still exist because crystalline melting point of PE is ≈110 °C whereas, for EVA, crystallites melt over a temperature region of 50–70 °C. The broad crystalline melting range reveals that EVA contains different types of crystallites having different internal order which need different amount of thermal energy for fusion. These crystals of EVA also have smaller thickness compared to polyethylene which is evident from the broad X-ray diffraction peak for EVA compared to that of LDPE (Fig. 2).

There is a gradual reduction of Young's modulus, elongation at break, and tensile strength of all compositions with the increase in measurement temperature. However, the rate of decrease of these properties with the increase in measurement temperature becomes more and more pronounced with the increase in EVA concentration in the blend. The measurement on 100% EVA cannot be completed even at 50 °C because of high elongation at break which cannot be accommodated in the experimental chamber.

Conclusions

The decrease in strain rate increases the degree of strain hardening and becomes more pronounced for EVA-rich blends. Young's modulus is directly proportional to the total crystallinity of the blend. The strain hardening of PE and PE-rich blends is mainly due to the change in internal order of crystallites with marginal increase in strain-induced crystallization. For EVA, during strain hardening, there is significant increase in strain-induced crystallization as revealed from both X-ray and DSC analysis.

The process of strain hardening is adversely affected by increase in temperature and it continues up to the crystalline melting point of the major component for the blends studied.

The authors are grateful to the Department of Science and Technology, New Delhi, India, and Polyolefins Industries Ltd., Bombay, India, for funding the project.

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EXHIBIT M

Dow's Log of Documents Withheld from Production on Grounds of Privilege in Civil Action 05-737

NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1	11	12/23/2003				Removed and produced	
2	43	08/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
3	24					Removed and produced	
4	2	08/05/2005	Johnson, Mark S; Gibbons, Julie	Anderson, Kenneth W; Cobler, Brad; Cotton, Robert; Eckel, Jason; Hazlitt, Lonnie; Heard, Mark; Larsen Jr, Douglas; Mcconnell, Dennis; Nietvelt, Paul; Reichek, Ken; Johnson, Mark S	Collick, Scott; Fordyce, William; Gibbons, Julie; Kanuch, Bruce; Krupp, Stephen; Marinelli, Joseph F; Mcalindon, Julie; Niemann, Debra; Roper, Harry J; Schwartz, Roger; Story, Bruce; Trybus, Steven R	E-mail correspondence providing information to counsel in anticipation of litigation in order to obtain legal services	AC, WP
5	1	08/05/2005				Removed and produced	

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
6	3	01/05/2005	Kanuch, Bruce M	Anderson, Kenneth W; Cardwell, Scott; Chum, Stephen; Coker, Wayne; Dekunder, Staci; Fordyce, William; Hazlitt, Lonnie; Johnson, Mark S; Kolthammer, Brian; Krupp, Stephen; Lai, Shih-Yaw; Larsen Jr, Douglas; Markovich, Ronald P; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Oswald, Thomas; Patterson, Leree; Redwine, David; Reichek, Ken; Schwartz, Roger; Stevens, James; Story, Bruce; Swogger, Kurt; Taha, Angela; Thomson, Kip; Weeks, Ron; Williams, Allen; Wright, Glenn	Kanuch, Bruce; Korfhage, Glenn; Ward, Susan	E-mail correspondence from B. Kanuch providing legal advice	AC
7	1	02/25/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
8	1	02/25/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
9	6	12/03/2002	Williams, Allen			Removed otherwise privileged document as irrelevant to this litigation	
10	36	10/30/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
11	1	11/05/2003	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
12	7	11/04/2003	Hazlitt, Lonnie	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of M. Glenn in anticipation of litigation	WP

Dow's Log of Documents Withheld from Production on Grounds of Privilege in Civil Action 05-737

NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
13	2	11/05/2003	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of M. Glenn in anticipation of litigation	WP
14	1	11/05/2003	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of M. Glenn in anticipation of litigation	WP
15	7	10/29/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
16	1	10/30/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
17	34	10/30/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
18	4	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
19	5	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
20	7	10/09/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
21	7	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
22	7	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
23	7	10/09/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
24	1	09/10/2003	Williams, Allen			Notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
25	1	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
26	11	10/10/2003	Hagen Jr, Charles			Testing performed at the request of M. Glenn in anticipation of litigation	WP
27	7	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
28	1	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
29	2	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
30	7	10/09/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
31	1	09/10/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
32	4	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
33	1	09/16/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
34	1	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
35	7	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
36	1	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
37	2	10/10/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
38	7	10/09/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
39	1	09/16/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
40	11	10/11/2003	Hagen Jr, Charles			Testing performed at the request of M. Glenn in anticipation of litigation	WP
41	3	10/03/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
42	1	09/23/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
43	11	10/20/2003	Hagen Jr, Charles			Testing performed at the request of M. Glenn in anticipation of litigation	WP
44	1	09/23/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
45	3	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
46	7					Removed because irrelevant to this litigation	
47	43	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
48	4	02/16/2004 - 05/11/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
49	1	02/16/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
50	1	02/25/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
51	1	02/28/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
52	1	03/09/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
53	1	04/22/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
54	1	04/26/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
55	1	05/11/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
56	1	05/27/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
57	1	2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
58	4	06/11/2004	Coker, Wayne			Testing performed at the request of G. Porter in anticipation of litigation	WP
59	1	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
60	1	05/24/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
61	1	05/24/2004	Hagen Jr, Charles	Johnson, Marilyn; Reichek, Ken; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
62	1	05/30/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
63	1	06/16/2004		Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
64	2	03/18/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
65	21	03/24/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
66	7	03/24/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
67	7	03/24/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
68	7	03/24/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
69	1	02/16/2004	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
70	17	10/27/2003	Reichek, Ken	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen		Testing performed at the request of M. Glenn in anticipation of litigation	WP
71	1	02/16/2004	Johnson, Mark S	Porter, Greg; Glenn, Michael L; Kanuch, Bruce M; Krupp, Stephen; Story, Bruce	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
72	6	02/13/2004	Wakefield, Charles; Reichek, Ken; Hazlitt, Lonnie; Johnson, Mark S	Porter, Greg; Glenn, Michael L; Kanuch, Bruce M; Krupp, Stephen; Story, Bruce		Action plan for testing performed at the request of G. Porter in anticipation of litigation	WP
73	1	03/19/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
74	7	03/18/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
75	1	03/18/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
76	7	03/17/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
77	1	03/17/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
78	2	03/18/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
79	1	03/22/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
80	2	03/22/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
81	1	03/19/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
82	7	03/19/2004	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
83	1	05/17/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
84	1	05/14/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
85	2	05/14/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
86	3	05/17/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
87	7	05/14/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
88	1	05/17/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
89	1	05/15/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
90	2	05/17/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
91	3	05/17/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
92	7	05/15/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
93	1	05/27/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
94	2	05/27/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
95	1	05/27/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
96	2	05/27/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
97	7	05/27/2004	Nelson, Mike	Hazlitt, Lonnie; Hegefeld, Neal; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	Testing performed at the request of G. Porter in anticipation of litigation	WP
98	2	02/16/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
99	15	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
100	12	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
101	15	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
102	15	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
103	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
104	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
105	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
106	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
107	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
108	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
109	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
110	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
111	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
112	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
113	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
114	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
115	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
116	6	03/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
117	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
118	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
119	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
120	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
121	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
122	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
123	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
124	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
125	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
126	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
127	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
128	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
129	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
130	6	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
131	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
132	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
133	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
134	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
135	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
136	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
137	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
138	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
139	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
140	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
141	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
142	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
143	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
144	6	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
145	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
146	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
147	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
148	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
149	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
150	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
151	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
152	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
153	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
154	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
155	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP

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156	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
157	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
158	6	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
159	43	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
160	1	04/28/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
161	2	04/28/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken; Zhou, Zhe	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
162	1	01/28/2005	Zhou, Zhe	Conboy, Claire; Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
163	4	01/28/2005	Zhou, Zhe; Conboy, Claire	Conboy, Claire; Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Reichek, Ken	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
164	1	02/04/2005	Zhou, Zhe	Conboy, Claire; Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
165	2	02/04/2005	Zhou, Zhe	Conboy, Claire; Johnson, Mark S; Taha, Angela		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
166	1	02/28/2005	Zhou, Zhe	Conboy, Claire; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
167	1	01/03/2005	Johnson, Mark S	Conboy, Claire; Crown, Alechia; Green, Shayne; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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168	1	10/17/2004	Johnson, Mark S	Hazlitt, Lonnie	Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
169	3	10/17/2004		Hazlitt, Lonnie	Taha, Angela	Testing performed at the request of H. Roper in anticipation of litigation	WP
170	1	06/23/2005	Johnson, Mark S	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Taha, Angela; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
171	7	06/23/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Taha, Angela; Zhou, Zhe		Testing performed at the request of H. Roper in anticipation of litigation	WP
172	1	06/23/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Taha, Angela; Zhou, Zhe		Testing performed at the request of H. Roper in anticipation of litigation	WP
173	1	06/23/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Taha, Angela; Zhou, Zhe		Testing performed at the request of H. Roper in anticipation of litigation	WP
174	1	08/27/2004	Johnson, Mark S	Hazlitt, Lonnie	Taha, Angela	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
175	6	08/18/2004	Taha, Angela	Hazlitt, Lonnie	Taha, Angela	Testing performed at the request of G. Porter in anticipation of litigation	WP
176	1	02/03/2005	Zhou, Zhe	Johnson, Mark S; Taha, Angela	Conboy, Claire; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
177	1	06/15/2005	Johnson, Mark S; Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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178	7	06/10/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe; Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
179	1	06/15/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe; Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
180	1	06/15/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
181	1	06/15/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela		Testing performed at the request of H. Roper in anticipation of litigation	WP
182	1	02/28/2005	Conboy, Claire	Coker, Wayne; Crown, Alechia; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela; Turk, Thelma; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
183	1	02/28/2005	Conboy, Claire	Coker, Wayne; Crown, Alechia; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela; Turk, Thelma; Zhou, Zhe		Testing performed at the request of H. Roper in anticipation of litigation	WP
184	2	02/2/2005	Zhou, Zhe	Johnson, Mark S; Taha, Angela	Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
185	1	02/01/2005	Zhou, Zhe	Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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186	2	02/01/2005	Zhou, Zhe	Taha, Angela		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
187	1	02/07/2005	Zhou, Zhe	Johnson, Mark S; Taha, Angela		E-mail correspondence providing attached reports regarding testing performed at the request of H. Roper in anticipation of litigation	WP
188	9	02/07/2005	Zhou, Zhe	Johnson, Mark S; Taha, Angela		Attached report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
189	1	02/07/2005	Conboy, Claire	Johnson, Mark S; Taha, Angela		Testing performed at the request of H. Roper in anticipation of litigation	WP
190	3	01/26/2005	Zhou, Zhe	Conboy, Claire; Crown, Alechia; Johnson, Mark S; Taha, Angela	Green, Shayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
191	1	06/02/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
192	8	06/02/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Testing performed at the request of H. Roper in anticipation of litigation	WP
193	1	04/29/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
194	1	01/28/2005	Conboy, Claire	Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
195	1	01/30/2005	Johnson, Mark S	Conboy, Claire; Crown, Alechia; Green, Shayne; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
196	1	06/23/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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197	2	01/05/2005	Johnson, Mark S	Conboy, Claire; Crown, Alechia; Green, Shayne; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
198	2	01/05/2005	Conboy, Claire	Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
199	3	01/05/2005	Crown, Alechia	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
200	2	06/15/2005	Johnson, Mark S	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
201	2	06/15/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
202	2	06/20/2005	Green, Shayne	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
203	1	06/15/2005	Zhou, Zhe	Conboy, Claire; Hazlitt, Lonnie; Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
204	1	02/02/2005	Johnson, Mark S; Zhou, Zhe	Taha, Angela; Zhou, Zhe; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
205	2	06/14/2005	Johnson, Mark S; Taha, Angela; Zhou, Zhe	Conboy, Claire; Taha, Angela; Zhou, Zhe; Johnson, Mark S; Green, Shayne	Hazlitt, Lonnie; Reichek, Ken; Coker, Wayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
206	3	06/15/2005	Hazlitt, Lonnie	Conboy, Claire; Johnson, Mark S; Taha, Angela; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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207	2	06/14/2005	Conboy, Claire; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Johnson, Mark S; Taha, Angela; Zhou, Zhe; Conboy, Claire	Hazlitt, Lonnie; Reichek, Ken; Coker, Wayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
208	1	06/15/2005	Zhou, Zhe	Conboy, Claire; Hazlitt, Lonnie; Johnson, Mark S; Taha, Angela	Chowdhury, Kasem	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
209	1	03/16/2005	Conboy, Claire	Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
210	2	08/19/2004	Johnson, Mark S; Taha, Angela	Taha, Angela; Johnson, Mark S; Redwine, David	Hazlitt, Lonnie; Williams, Allen; Coker, Wayne	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
211	2	08/18/2004	Redwine, David; Johnson, Mark S; Taha, Angela	Johnson, Mark S; Taha, Angela; Redwine, David	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
212	2	08/18/2004	Johnson, Mark S; Taha, Angela	Redwine, David; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
213	1	08/18/2004	Redwine, David	Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
214	1	08/18/2004	Johnson, Mark S	Redwine, David; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
215	1	08/05/2004	Johnson, Mark S	Taha, Angela		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
216	2	01/25/2005	Johnson, Mark S	Crown, Alechia; Taha, Angela	Conboy, Claire; Green, Shayne; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
217	2	01/16/2005	Crown, Alechia	Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
218	1	01/14/2005	Conboy, Claire	Zhou, Zhe	Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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219	2	01/14/2005	Crown, Alechia	Johnson, Mark S; Taha, Angela	Conboy, Claire; Green, Shayne; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
220	1	01/12/2005	Zhou, Zhe	Conboy, Claire	Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
221	3	01/12/2005	Zhou, Zhe	Conboy, Claire	Taha, Angela	Testing performed at the request of H. Roper in anticipation of litigation	WP
222	2	01/26/2005	Conboy, Claire	Crown, Alechia; Johnson, Mark S; Taha, Angela	Green, Shayne; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
223	3	08/19/2004	Redwine, David	Taha, Angela		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
224	3	01/26/2005	Crown, Alechia	Conboy, Claire; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Green, Shayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
225	3	08/16/2005	Hazlitt, Lonnie	Johnson, Mark S; Redwine, David; Taha, Angela; Zhou, Zhe	Coker, Wayne; Conboy, Claire	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
226	3	08/15/2005	Johnson, Mark S	Redwine, David; Taha, Angela; Zhou, Zhe	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
227	2	08/15/2005	Johnson, Mark S	Redwine, David; Zhou, Zhe	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
228	2	08/15/2005	Zhou, Zhe	Johnson, Mark S; Redwine, David	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
229	2	08/15/2005	Johnson, Mark S	Redwine, David; Zhou, Zhe	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
230	3	08/16/2005	Hazlitt, Lonnie	Johnson, Mark S; Redwine, David; Taha, Angela; Zhou, Zhe	Coker, Wayne; Conboy, Claire	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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231	1	02/03/2005	Johnson, Mark S	Taha, Angela; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
232	2	02/11/2005	Johnson, Mark S	Conboy, Claire; Crown, Alechia; Green, Shayne; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
233	3	02/11/2005	Crown, Alechia	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
234	2	01/31/2005	Zhou, Zhe	Conboy, Claire; Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
235	1	05/18/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
236	5	05/18/2005	Zhou, Zhe; Green, Shayne; Conboy, Claire	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Presentation regarding testing performed at the request of H. Roper in anticipation of litigation	WP
237	1	02/03/2005	Zhou, Zhe	Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
238	1	01/27/2005	Johnson, Mark S	Crown, Alechia; Green, Shayne; Taha, Angela; Zhou, Zhe	Conboy, Claire; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
239	2	01/26/2005	Johnson, Mark S	Crown, Alechia; Green, Shayne; Taha, Angela; Zhou, Zhe	Conboy, Claire; Hazlitt, Lonnie; Reichek, Ken	Meeting minutes containing analysis of testing performed at the request of H. Roper in anticipation of litigation	WP

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240	2	07/18/2003	Johnson, Mark S	Anderson, Kenneth W; Crim, Brad; Dekunder, Staci; Fordyce, William; Sehanobish, Kalyan; Cobler, Brad; Dowling, Nicole; Koch, Kaeyln; Niemann, Debra; Ramsey, David; Wooster, Jeffrey J; Degroot, Willem; Gillespie, David; Hazlitt, Lonnie; Karjala, Teresa; Bernier, Robert; Kolthammer, Brian W.S; Eversdyk, David; Jain, Pradeep; McConnell, Dennis; Krupp, Stephen; Story, Bruce	Turk, Thelma	Redaction: Agenda item reflecting attorney-client privileged communication with S. Krupp	AC
241	1	09/9/2003	Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn	Hazlitt, Lonnie	E-mail correspondence regarding analysis performed at the request of M. Glenn in anticipation of litigation	WP
242	22	09/09/2003	Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn	Hazlitt, Lonnie	Presentation regarding testing and infringement analysis performed at the request of M. Glenn in anticipation of litigation	WP
243	1	10/24/2003	Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn	Combs, Bruce; Fordyce, William; Koch, Kaelyn; Story, Bruce; Thomson, Kip	E-mail correspondence providing presentation prepared at request of M. Glenn in anticipation of litigation	WP

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244	24	10/24/2003	Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn	Combs, Bruce; Fordyce, William; Koch, Kaelyn; Story, Bruce; Thomson, Kip	Presentation regarding testing and infringement analysis prepared at the request of M. Glenn in anticipation of litigation	WP
245	1	06/10/2004	Johnson, Mark S	Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree	Bernier, Robert; Cobler, Brad; Desjardins, Sylvie; Eversdyk, David; Kardos, Lori; Krupp, Stephen	E-mail correspondence providing presentation prepared at request of M. Glenn in anticipation of litigation	WP
246	24	06/10/2004	Johnson, Mark S	Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree	Bernier, Robert; Cobler, Brad; Desjardins, Sylvie; Eversdyk, David; Kardos, Lori; Krupp, Stephen	Presentation regarding testing and analysis prepared at the request of M. Glenn in anticipation of litigation	WP
247	36	08/18/2003	Krupp, Stephen; Johnson, Mark S; Billings, Mike; Dekunder, Staci; Larsen, Douglas; McConnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn			Presentation slides regarding infringement analysis providing legal advice of S. Krupp and summarizing information for counsel in order to obtain legal advice.	AC
248	8	08/18/2003	Krupp, Stephen			Draft presentation providing legal analysis and strategy for testing in anticipation of litigation	AC, WP
249	11	03/02/2006		Glenn; Hazlitt, Lonnie; Kanuch, Bruce; Kolthammer, Brian ,; Korfhage; Roper, Harry; Trybus, Steven		Attached information provided to counsel in e-mail from Mark Johnson in order to obtain legal advice	AC
250	5	08/14/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP

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251	91	03/07/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
252	156	09/21/2004	Hazlitt, Lonnie			Testing performed at the request of G. Porter in anticipation of litigation	WP
253	2	02/02/2005	Hazlitt, Lonnie			Outline regarding testing analysis prepared at the request of H. Roper in anticipation of litigation	WP
254	238	01/22/2007	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
255	22	07/13/2004	Hazlitt, Lonnie			Testing performed at the request of G. Porter in anticipation of litigation	WP
256	8	01/26/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
257	118	11/29/2004	Hazlitt, Lonnie			Testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
258	8	01/17/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
259	46	10/29/2004	Hazlitt, Lonnie			Testing performed at the request of G. Porter in anticipation of litigation	WP
260	29		Hazlitt, Lonnie			Removed otherwise privileged document as irrelevant to this litigation	
261	17	10/27/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
262	40	08/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
263	40	08/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
264	43	08/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
265	41	08/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
266	6	04/08/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
267	6	01/26/2007	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
268	31	10/17/2004	Hazlitt, Lonnie			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
269	4	02/10/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
270	81	12/14/2004	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
271	81	12/14/2004	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
272	10	07/27/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
273	7	08/13/2004	Hazlitt, Lonnie			Testing performed at the request of G. Porter in anticipation of litigation	WP
274	27	05/11/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
275	27	05/11/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
276	24	11/18/2004	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
277	1	06/01/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
278	8	04/19/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
279	1	04/28/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
280	2	04/28/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken; Zhou, Zhe	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
281	2	09/03/2004	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		E-mail regarding testing performed at the request of G. Porter in anticipation of litigation	WP
282	2	09/03/2004	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
283	1	09/14/2005	Reichek, Ken	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
284	93	09/13/2005	Reichek, Ken	Hazlitt, Lonnie		Testing performed at the request of H. Roper in anticipation of litigation	WP
285	1	06/01/2004	Williams, Allen	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
286	43	06/01/2004	Williams, Allen	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	Testing performed at the request of G. Porter in anticipation of litigation	WP
287	1	06/01/2004	Williams, Allen	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
288	53	03/10/2004	Williams, Allen	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	Testing performed at the request of G. Porter in anticipation of litigation	WP
289	53	05/14/2004	Williams, Allen	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	Testing performed at the request of G. Porter in anticipation of litigation	WP
290	53	05/19/2004	Williams, Allen	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	Testing performed at the request of G. Porter in anticipation of litigation	WP
291	53	05/27/2004	Williams, Allen	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	Testing performed at the request of G. Porter in anticipation of litigation	WP
292	1	06/11/2004	Coker, Wayne	Johnson, Mark S	Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
293	4	06/11/2004	Coker, Wayne	Johnson, Mark S	Hazlitt, Lonnie; Williams, Allen	Testing performed at the request of G. Porter in anticipation of litigation	WP
294	1	06/14/2004	Coker, Wayne	Hazlitt, Lonnie; Johnson, Mark S; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
295	4	06/11/2004	Coker, Wayne	Hazlitt, Lonnie; Johnson, Mark S; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
296	1	08/17/2005	Johnson, Mark S	Balke, Stephen T	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
297	2	03/19/2004	Reichek, Ken	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
298	2	03/19/2004	Reichek, Ken	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP

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299	1	08/27/2004	Johnson, Mark S	Hazlitt, Lonnie	Taha, Angela	E-mail correspondence providing report regarding testing performed at the request of G. Porter in anticipation of litigation	WP
300	6	08/18/2004	Taha, Angela	Hazlitt, Lonnie	Taha, Angela	Testing performed at the request of G. Porter in anticipation of litigation	WP
301	1	02/01/2005	Johnson, Mark S; Kanuch, Bruce M	Hazlitt, Lonnie; Johnson, Mark S; Trybus, Steven R; Roper, Harry J		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation and reflecting attorney-client communications with B. Kanuch, Esq.	AC, WP
302	1	03/19/2004	Reichek, Ken	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
303	1	09/16/2003	Williams, Allen	Johnson, Mark S; Reichek, Ken		Report regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
304	1	03/19/2004	Reichek, Ken	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
305	1	09/10/2003	Williams, Allen	Johnson, Mark S; Reichek, Ken		Report regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
306	1	08/16/2005	Redwine, David	Hazlitt, Lonnie		E-mail correspondence providing report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
307	21	08/16/2005	Zhou, Zhe	Hazlitt, Lonnie		Presentation regarding testing performed at the request of H. Roper in anticipation of litigation	WP
308	1	09/03/2003	Johnson, Mark S	Hazlitt, Lonnie		E-mail correspondence providing report regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
309	1	07/24/2003	Nelson, Mike	Hazlitt, Lonnie		Removed and produced	

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
310	2	07/18/2003	Johnson, Mark S	Anderson, Kenneth W; Bernier, Robert; Cobler, Brad; Crim, Brad; deGroot, A Willem; Dekunder, Staci; Dowling, Nicole; Eversdyk, David; Fordyce, William; Gillespie, David; Hazlitt, Lonnie; Jain, Pradeep; Karjala, Teresa; Koch, Kaelyn; Kolthammer, Brian; Krupp, Stephen; Mcconnell, Dennis; Niemann, Debra; Ramsey, David; Sehanobish, Kalyan; Story, Bruce; Wooster, Jeffrey	Turk, Thelma	Redaction: Agenda item reflecting attorney-client privileged communication with S. Krupp	AC
311	1	02/28/2005	Conboy, Claire	Coker, Wayne; Crown, Alechia; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela; Turk, Thelma; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
312	1	02/28/2005	Conboy, Claire	Coker, Wayne; Crown, Alechia; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela; Turk, Thelma; Zhou, Zhe		Presentation regarding testing performed at the request of H. Roper in anticipation of litigation	WP
313	1	02/16/2004	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
314	17	10/27/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
315	1	03/03/2005	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence providing reports regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
316	67	09/24/2003	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Report regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
317	66	09/24/2003	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Report regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
318	68	09/24/2003	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Report regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
319	1	05/31/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
320	7	05/31/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Presentation regarding testing performed at the request of H. Roper in anticipation of litigation	WP
321	1	09/09/2003	Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn	Hazlitt, Lonnie	E-mail correspondence regarding presentation prepared at the request of M. Glenn in anticipation of litigation	WP
322	22	09/09/2003	Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn	Hazlitt, Lonnie	Presentation regarding testing and infringement analysis prepared at the request of M. Glenn in anticipation of litigation	WP
323	1	02/16/2004	Johnson, Mark S	Kanuch, Bruce; Krupp, Stephen; Glenn, Michael L; Porter, Greg; Story, Bruce	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
324	6	02/13/2004	Johnson, Mark S	Kanuch, Bruce; Krupp, Stephen; Glenn, Michael L; Porter, Greg; Story, Bruce	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen	Removed from privilege log: Duplicate of Number 72.	

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325	2	08/05/2005	Johnson, Mark S	Anderson, Kenneth W; Cobler, Brad; Cotton, Robert; Eckel, Jason; Hazlitt, Lonnie; Heard, Mark; Larsen Jr, Douglas; Mcconnell, Dennis; Nietvelt, Paul; Reichek, Ken	Collick, Scott; Fordyce, William; Gibbons, Julie; Kanuch, Bruce; Krupp, Stephen; Marinelli, Joseph F; Mcalindon, Julie; Niemann, Debra; Roper, Harry J; Schwartz, Roger; Story, Bruce; Trybus, Steven R	E-mail correspondence providing information to counsel in order to obtain legal advice	AC
326	1	08/05/2005				Remove and produce	
327	1	12/01/2004	Johnson, Mark S	Anderson, Kenneth W; Chum, Stephen; Hazlitt, Lonnie; Jain, Pradeep; Kolthammer, Brian; Krupp, Stephen; Lai, Shih-Yaw; Markovich, Ronald P; Mcconnell, Dennis; Niemann, Debra; Oswald, Thomas; Weeks, Ron		E-mail correspondence attaching information for counsel in order to obtain legal advice	AC
328	12	05/06/2004		Anderson, Kenneth W; Chum, Stephen; Hazlitt, Lonnie; Jain, Pradeep; Kolthammer, Brian; Krupp, Stephen; Lai, Shih-Yaw; Markovich, Ronald P; Mcconnell, Dennis; Niemann, Debra; Oswald, Thomas; Weeks, Ron		Attached patent application publication provided to counsel in order to obtain legal advice	AC
329	1	06/01/2005	Johnson, Mark S	Barlow, Aaron A; Kanuch, Bruce; Roper, Harry; Trybus, Steven	Balke, Stephen T; Hazlitt, Lonnie; Krupp, Stephen	E-mail correspondence attaching information for counsel in order to obtain legal advice	AC
330	9	06/01/2005		Barlow, Aaron A; Kanuch, Bruce; Roper, Harry; Trybus, Steven		Attached patent provided to counsel in order to obtain legal advice	AC

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331	1	11/16/2004	Johnson, Mark S	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
332	24	09/04/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
333	41	08/22/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
334	1	03/26/2002	Hazlitt, Lonnie			Removed and produced	
335	1	07/20/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
336	8	07/20/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Taha, Angela		Presentation regarding testing performed at the request of H. Roper in anticipation of litigation	WP
337	1	09/10/2003	Williams, Allen	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
338	1	09/10/2003	Williams, Allen	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken		Notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
339	1	05/25/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
340	2	04/29/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
341	2	04/29/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
342	1	04/29/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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343	2	05/02/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
344	2	09/03/2004	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
345	2	09/03/2004	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
346	1	01/28/2005	Conboy, Claire	Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
347	2	06/20/2005	Green, Shayne	Coker, Wayne; Johnson, Mark S; Nelson, Mike; Reichek, Ken	Conboy, Claire; Hazlitt, Lonnie; Taha, Angela; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
348	1	06/11/2004	Johnson, Mark S	Coker, Wayne	Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
349	1	08/29/2003	Johnson, Mark S	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
350	1	03/03/2005	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
351	1	03/08/2005	Johnson, Mark S	Balke, Stephen T	Hazlitt, Lonnie; Reichek, Ken; Turk, Thelma	E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
352	1	03/07/2005	Balke, Stephen T	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
353	1	08/17/2005	Balke, Stephen T	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP

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354	1	09/10/2003	Johnson, Mark S	Gillespie, David	Arnoudse, Peter; deGroot, A Willem; Hazlitt, Lonnie; Li Pi Shan, Colin	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
355	1	03/09/2005	Johnson, Mark S	Coker, Wayne; Reichek, Ken	Hazlitt, Lonnie; Kay, Ivonne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
356	1	05/23/2005	Johnson, Mark S	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
357	4	03/02/2005	Conboy, Claire	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
358	3	03/01/2005	Conboy, Claire	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
359	2	03/01/2005	Conboy, Claire	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
360	2	03/01/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Crown, Alechia; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela; Turk, Thelma		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
361	1	03/01/2005	Johnson, Mark S	Conboy, Claire	Hazlitt, Lonnie	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
362	4	03/02/2005	Johnson, Mark S	Conboy, Claire; Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
363	1	01/26/2005	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
364	1	01/21/2005	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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365	1	05/31/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
366	2	08/18/2004	Taha, Angela	Johnson, Mark S; Redwine, David	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
367	4	08/18/2004	Taha, Angela	Johnson, Mark S; Redwine, David	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	Report regarding testing performed at the request of G. Porter in anticipation of litigation	WP
368	1	08/18/2004	Johnson, Mark S	Redwine, David; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
369	2	08/18/2004	Johnson, Mark S	Redwine, David; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
370	2	06/05/2005	Kanuch, Bruce M	Barlow, Aaron A; Johnson, Mark S; Roper, Harry; Trybus, Steven	Balke, Stephen T; Hazlitt, Lonnie; Krupp, Stephen	E-mail correspondence reflecting attorney-client communication with B. Kanuch, Esq.	AC
371	1	02/10/2004	Johnson, Mark S	Williams, Allen	Hazlitt, Lonnie	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
372	1	05/12/2005	Green, Shayne	Johnson, Mark S; Zhou, Zhe	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
373	2	05/12/2005	Zhou, Zhe	Johnson, Mark S	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
374	1	05/04/2005	Johnson, Mark S	Balke, Stephen T	Hazlitt, Lonnie; Reichek, Ken; Turk, Thelma	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
375	2	05/04/2005	Balke, Stephen T	Johnson, Mark S; Turk, Thelma	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP

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376	2	05/04/2005	Johnson, Mark S	Balke, Stephen T; Turk, Thelma	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
377	3	05/05/2005	Balke, Stephen T	Johnson, Mark S; Turk, Thelma	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
378	1	05/09/2005	Balke, Stephen T	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken; Turk, Thelma	E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
379	1	03/08/2004	Johnson, Mark S	Hazlitt, Lonnie; Johnson, Mark S; Krupp, Stephen; Reichek, Ken; Williams, Allen	Turk, Thelma	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
380	1	05/18/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
381	1	08/13/2004	Johnson, Mark S	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
382	2	08/15/2005	Johnson, Mark S	Redwine, David; Zhou, Zhe	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
383	2	08/15/2005	Zhou, Zhe	Johnson, Mark S; Redwine, David	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
384	2	08/15/2005	Johnson, Mark S	Redwine, David; Zhou, Zhe	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
385	3	08/15/2005	Johnson, Mark S	Redwine, David; Taha, Angela; Zhou, Zhe	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
386	1	03/07/2005	Johnson, Mark S	Hazlitt, Lonnie	Reichek, Ken; Turk, Thelma	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
387	1	04/14/2005	Turk, Thelma	Plastics R&D Department		E-mail correspondence on behalf of S. Krupp, Esq. requesting information in order to provide legal advice	AC
388	2	02/11/2005	Johnson, Mark S	Conboy, Claire; Crown, Alechia; Green, Shayne; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
389	3	02/11/2005	Crown, Alechia	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
390	2	01/31/2005	Johnson, Mark S	Conboy, Claire; Crown, Alechia; Green, Shayne; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
391	2	01/31/2005	Zhou, Zhe	Conboy, Claire; Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
392	2	02/01/2005	Conboy, Claire	Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
393	3	09/07/2004	Johnson, Mark S	Porter, Greg	Glenn, Michael; Hazlitt, Lonnie; Kanuch, Bruce; Krupp, Stephen; Story, Bruce; Wright, Glenn	E-mail correspondence providing information to counsel in order to obtain legal advice	AC
394	15	09/07/2004	Tas, P; Nguyen, L; Marshall, S; Kashanian, M	Porter, Greg	Glenn, Michael; Hazlitt, Lonnie; Kanuch, Bruce; Krupp, Stephen; Story, Bruce; Wright, Glenn	Product information provided to counsel in order to obtain legal advice	AC

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395	17	09/07/2004	Aubee, N; Dobbin, C; Marshall, S; Swabey, T	Porter, Greg	Glenn, Michael; Hazlitt, Lonnie; Kanuch, Bruce; Krupp, Stephen; Story, Bruce; Wright, Glenn	Attached product information provided to counsel in order to obtain legal advice	AC
396	12	09/07/2004	Weeks, Ron	Porter, Greg	Glenn, Michael; Hazlitt, Lonnie; Kanuch, Bruce; Krupp, Stephen; Story, Bruce; Wright, Glenn	Product information provided to counsel in order to obtain legal advice	AC
397	1	05/18/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
398	5	05/18/2005	Zhou, Zhe; Green, Shayne; Conboy, Claire	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
399	1	09/14/2005	Reichek, Ken	Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
400	89	01/18/2005	Reichek, Ken	Hazlitt, Lonnie		Testing performed at the request of H. Roper in anticipation of litigation	WP
401	226	09/12/2005		Hazlitt, Lonnie		Testing performed at the request of H. Roper in anticipation of litigation	WP
402	1	04/14/2005	Turk, Thelma	Plastics R&D Department		E-mail correspondence on behalf of S. Krupp, Esq. requesting information in order to provide legal advice	AC
403	17	04/14/2005		Plastics R&D Department		Attached report from S. Krupp with request of information in order to provide legal advice	AC
404	103	01/17/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
405	226	09/12/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP

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406	81	01/17/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
407	3		McKinney, Ozborne K	Krupp, Stephen		Handwritten notes regarding infringement analysis prepared in anticipation of prior litigation and sent from one attorney to another in order to provide legal advice	AC, WP
408	3	04/08/2005	Pielech, Connie M	Gold, Solomon M		Letter reflecting attorney-client privileged communications regarding foreign patent prosecution	AC
409	18	04/04/2005	Jenner & Block			Analysis prepared by outside counsel providing legal advice in anticipation of litigation	AC, WP
410	4	01/19/2004-02/19/2004	Jenkens & Gilchrist			Timeline prepared by outside counsel in anticipation of litigation	WP
411	3	01/19/2004-02/19/2004	Jenkens & Gilchrist			Timeline prepared by outside counsel in anticipation of litigation	WP
412	2	01/19/2004-02/19/2004	Jenkens & Gilchrist			Chart prepared by outside counsel in anticipation of litigation	WP
413	2	01/19/2004-02/19/2004	Jenkens & Gilchrist			Chart prepared by outside counsel in anticipation of litigation	WP
414	5	10/22/1998	McKinney, Osborne K.			Data analysis performed by O. McKinney in anticipation of prior litigation	WP
415	1		McKinney, Osborne K.			Handwritten notes analyzing patent applications reflecting attorney-client communications regarding patent portfolio with K. Swogger, S. Chum, and B. Story	AC
416	45					Draft portion of patent application analyzing patent applications reflecting attorney-client communications	AC
417	34					Draft portion of patent application analyzing patent applications reflecting attorney-client communications	AC
418	2	01/20/2000	Sawchuk, Rebecca	Krupp, Stephen		Facsimile sent to counsel providing information in order to obtain legal advice	AC

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419	1	03/18/1998	Schrock, Nancy; Krupp, Stephen	Plotecher, Gary		Facsimile sent between in-house counsel S. Krupp and outside counsel G. Plotecher regarding IP portfolio strategy	AC
420	1	05/17/1999	Schrock, Nancy	Dickerson, James		E-mail correspondence to attorney requesting legal advice	AC
421	18	05/1999	Dickerson, James; Sims, Norm; Arnold, Kelly LS; Krupp, Stephen;; Plotecher, Gary			Report and handwritten notes prepared by counsel and reflecting attorney-client privileged communications among K. Anderson, J. Lastovica, Dow Legal Department, and outside counsel	AC
422	7	05/26/1999	Krupp, Stephen	Alverson, Janice		E-mail from counsel reflecting attorney-client privileged communications with S. Krupp, Esq.	AC
423	2	05/26/1999	Krupp, Stephen	Alverson, Janice		E-mail from counsel reflecting attorney-client privileged communications with S. Krupp, Esq.	AC
424	5	05/06/1999	Krupp, Stephen	Alverson, Janice		E-mail from counsel reflecting attorney-client privileged communications with S. Krupp, Esq.	AC
425	13	05/06/1999	Krupp, Stephen	Alverson, Janice		E-mail from counsel reflecting attorney-client privileged communications with S. Krupp, Esq.	AC
426	6	10/20/1998	McKinney, Ozborne K			Modeling prepared by O. McKinney in anticipation of prior litigation	WP
427	29		McKinney, Ozborne K			Report analyzing prior art prepared by counsel in anticipation of prior litigation	WP
428	2		Chum, Stephen; Johnson, Mark S.			Flowchart and handwritten notes regarding infringement analysis prepared by counsel in anticipation of prior litigation	WP
429	1	10/00/1998	McKinney, Ozborne K			Flowchart prepared in anticipation of prior litigation	WP
430	1					File folder cover of testing performed at the request of counsel in anticipation of litigation	WP
431	7	02/2005 - 03/04/2005	Taha, Angela			Testing performed at the request of H. Roper in anticipation of litigation	WP

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432	1	05/25/2005	Johnson, Mark S	Zhou, Zhe; Green, Shayne; Taha, Angela; Conboy, Claire	Hazlitt, Lonnie; Reichek, Ken; Crown, Alechia; Coker, Wayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
433	8	05/25/2005		Zhou, Zhe; Green, Shayne; Taha, Angela; Conboy, Claire	Hazlitt, Lonnie; Reichek, Ken; Crown, Alechia; Coker, Wayne	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
434	1	06/03/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
435	4	06/03/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
436	2	05/27/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
437	1	05/19/2005	Sun, Kefu	Reichek, Ken		E-mail correspondence attaching report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
438	5	05/19/2005	Sun, Kefu	Reichek, Ken		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
439	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP
440	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP
441	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP
442	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP
443	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP

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444	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP
445	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP
446	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP
447	2	03/20/2006	Williams, Allen			Testing performed at the request of H. Roper in anticipation of litigation	WP
448	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
449	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
450	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
451	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
452	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
453	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
454	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
455	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
456	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
457	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
458	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
459	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
460	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
461	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
462	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP

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463	2	06/12/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
464	1	03/04/2005	Johnson, Mark S	Conboy, Claire	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
465	1	06/23/2005	Nelson, Mike	Johnson, Mark S; Reichek, Ken	Gillespie, David	E-mail correspondence attaching reports regarding testing performed at the request of H. Roper in anticipation of litigation	WP
466	1	06/23/2005	Nelson, Mike	Johnson, Mark S; Reichek, Ken	Gillespie, David	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
467	1	06/23/2005	Nelson, Mike	Johnson, Mark S; Reichek, Ken	Gillespie, David	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
468	7	06/23/2005	Nelson, Mike	Johnson, Mark S; Reichek, Ken	Gillespie, David	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
469	1	06/15/2005	Nelson, Mike	Johnson, Mark S; Reichek, Ken	Gillespie, David	E-mail correspondence attaching reports regarding testing performed at the request of H. Roper in anticipation of litigation	WP
470	1	06/15/2005	Nelson, Mike	Johnson, Mark S; Reichek, Ken	Gillespie, David	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
471	7	06/10/2005	Nelson, Mike	Johnson, Mark S; Reichek, Ken	Gillespie, David	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
472	1	06/17/2005	Johnson, Mark S	Coker, Wayne; Nelson, Mike; Reichek, Ken	Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Taha, Angela; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
473	1	06/15/2005	Johnson, Mark S	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe		E-mail correspondence attaching reports regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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474	7	06/10/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
475	1	06/15/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
476	1	06/15/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela		E-mail correspondence attaching report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
477	1	06/15/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
478	2	06/03/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence attaching report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
479	4	06/03/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
480	1	06/08/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
481	6	06/08/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Reichek, Ken	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
482	1	05/31/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
483	7	05/31/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
484	1	05/26/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
485	1	06/02/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
486	8	06/02/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
487	2	06/20/2005	Green, Shayne	Coker, Wayne; Johnson, Mark S; Nelson, Mike; Reichek, Ken	Conboy, Claire; Hazlitt, Lonnie; Taha, Angela; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
488	2	06/15/2005	Johnson, Mark S	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
489	1	06/08/2005	Taha, Angela	Conboy, Claire; Green, Shayne; Johnson, Mark S; Zhou, Zhe	Coker, Wayne; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
490	1	05/31/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
491	1	05/27/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding privileged testing performed at the request of H. Roper in anticipation of litigation	WP

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492	2	06/02/2005	Johnson, Mark S	Conboy, Claire; Green, Shayne; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding privileged testing performed at the request of H. Roper in anticipation of litigation	WP
493	2	05/27/2005	Conboy, Claire	Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding privileged testing performed at the request of H. Roper in anticipation of litigation	WP
494	1	05/27/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
495	4	10/03/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
496	3	09/04/2003 - 10/03/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
497	4	10/11/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
498	4	09/02/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
499	4	09/02/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
500	6	06/01/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
501	4	01/25/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
502	5	01/10/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
503	4	01/10/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
504	93	09/14/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
505	3	05/31/2006	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
506	89	01/24/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP

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507	67	03/03/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
508	66	03/03/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
509	68	03/03/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
510	91	04/10/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
511	4	07/07/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
512	4	04/06/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
513	111	05/03/2004	Hazlitt, Lonnie			Analysis of testing performed at the request of G. Porter in anticipation of litigation	WP
514	111	01/17/2004	Reichek, Ken			Analysis of testing performed at the request of G. Porter in anticipation of litigation	WP
515	130	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
516	147	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
517	167	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
518	139	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
519	118	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
520	122	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
521	173	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
522	117	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
523	176	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
524	163	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP

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525	116	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
526	147	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
527	92	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
528	183	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
529	104	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
530	130	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
531	143	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
532	111	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
533	115	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
534	110	04/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
535	149	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
536	110	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
537	13	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
538	101	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
539	89	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
540	88	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
541	95	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
542	108	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
543	132	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
544	105	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
545	112	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
546	106	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
547	100	03/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
548	70	04/04/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
549	67	04/04/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
550	63	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
551	66	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
552	76	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
553	66	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
554	62	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
555	60	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
556	70	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
557	58	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
558	59	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
559	72	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
560	62	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
561	60	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
562	62	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
563	65	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
564	52	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
565	63	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
566	67	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
567	54	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
568	66	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
569	68	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
570	70	04/22/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
571	64	04/23/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
572	50	04/23/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
573	126	04/23/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
574	62	04/23/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
575	66	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
576	84	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
577	57	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
578	87	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
579	80	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
580	70	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
581	57	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
582	69	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
583	54	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
584	76	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
585	74	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
586	80	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
587	59	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
588	60	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
589	47	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
590	56	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
591	79	04/29/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
592	116	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
593	112	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
594	142	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
595	150	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
596	148	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
597	141	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
598	170	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
599	92	12/21/2004				Testing performed at the request of H. Roper in anticipation of litigation	WP
600	196	12/21/2004				Testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
601	94	12/21/2004				Testing performed at the request of H. Roper in anticipation of litigation	WP
602	106	12/21/2004				Testing performed at the request of H. Roper in anticipation of litigation	WP
603	95	12/21/2004				Testing performed at the request of H. Roper in anticipation of litigation	WP
604	97	12/21/2004				Testing performed at the request of H. Roper in anticipation of litigation	WP
605	108	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
606	127	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
607	145	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
608	155	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
609	159	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
610	138	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
611	125	06/04/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
612	103	01/17/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
613	107	01/17/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
614	129	01/17/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
615	41	08/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
616	24	09/04/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
617	1	02/08/2001	McKinney, Osborne K.	Van Dun, Jozef	Dekunder, Staci; Degroot, Jackie; Oswald, Thomas	E-mail correspondence regarding patents-in-suit and reflecting attorney-client privileged communication with O. McKinney, Esq.	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
618	1	02/08/2001	McKinney, Ozborne K	Van Dun, Jozef	Dekunder, Staci; Degroot, Jackie; Oswald, Tom	Removed from privilege log. Duplicate of No. 617	
619	11		Johnson, Mark S			Removed and produced	
620	43	08/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
621	315					Removed and produced	
622	24	09/04/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
623	3	08/18/2003	Gillespie, David			Testing performed at the request of M. Glenn in anticipation of litigation	WP
624	10	06/25/1992 - 09/15/92	Markovich, Ronald P			Draft of invention disclosure provided to Dow legal department in order to obtain legal advice regarding patentability from S. Krupp	AC
625	2	06/25/1992	Markovich, Ronald P			Draft of invention disclosure provided to Dow legal department in order to obtain legal advice regarding patentability from S. Krupp	AC
626	1	04/16/1993	Markovich, Ronald P			Draft of portion of specification of patents-in-suit prepared at the request of S. Krupp and reflecting attorney-client communications with S. Krupp	AC
627	2	04/19/1993	Markovich, Ronald P			Draft of portion of specification of patents-in-suit prepared at the request of an attorney and reflecting attorney-client communications with S. Krupp	AC
628	2	04/27/1993	Markovich, Ronald P			Draft of portion of specification of patents-in-suit prepared at the request of an attorney and reflecting attorney-client communications with S. Krupp	AC
629	1	04/08/1993	Markovich, Ronald P	Krupp, Stephen		Correspondence providing technical information to counsel in order to obtain legal advice regarding patent application	AC
630	1		Markovich, Ronald P			Removed and produced	

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
631	12	06/25/1992 - 09/15/92	Markovich, Ronald P			Draft of invention disclosure provided to Dow legal department in order to obtain legal advice regarding patentability from S. Krupp	AC
632	10	06/25/1992 - 09/15/92	Markovich, Ronald P			Draft of invention disclosure provided to Dow legal department in order to obtain legal advice regarding patentability from S. Krupp	AC
633	13	06/25/1992 - 09/15/92	Markovich, Ronald P			Draft of invention disclosure provided to Dow legal department in order to obtain legal advice regarding patentability from S. Krupp	AC
634	5	01/27/1993	Markovich, Ronald P	Krupp, Stephen		Correspondence providing technical information to counsel in order to obtain legal advice regarding patent application	AC
635	20		Markovich, Ronald P			Removed and produced	
636	5		Markovich, Ronald P			Removed and produced	
637	12		Markovich, Ronald P			Removed and produced	
638	5	11/15/1993 - 1/27/1995	Markovich, Ronald P			Notes reflecting legal advice of N. Warrick, Esq. and S. Krupp, Esq. regarding testing during the prosecution of the patents-in-suit	AC
639	1	11/20/2007	Markovich, Ronald P			Notes reflecting legal advice of N. Warrick, Esq. and S. Krupp, Esq. regarding testing during the prosecution of the patents-in-suit	AC
640	1		Markovich, Ronald P			Removed as not relevant to this litigation	
641	17		Markovich, Ronald P			Removed and produced	
642	16		Markovich, Ronald P			Removed and produced	
643	3	10/30/1994 - 12/04/1994	Markovich, Ronald P			Removed and produced	
644	1	10/09/1995	Markovich, Ronald P			Information reflecting attorney-client communications with O. McKinney regarding legal services related to patentability	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
645	2	06/13/1997	Markovich, Ronald P			Notes reflecting legal advice of O. McKinney regarding testing during the prosecution of the patents-in-suit	AC
646	1	06/13/1997	Markovich, Ronald P			Notes reflecting legal advice of O. McKinney regarding testing during the prosecution of the patents-in-suit	AC
647	2	06/13/1997	Markovich, Ronald P			Notes reflecting legal advice of O. McKinney regarding testing during the prosecution of the patents-in-suit	AC
648	2	09/21/1995	Markovich, Ronald P			Notes reflecting attorney-client communications with O. McKinney regarding terms in patents and work requested by counsel	AC
649	1		Markovich, Ronald P			Removed and produced	
650	4		Markovich, Ronald P			Removed and produced	
651	2	01/27/1995	Markovich, Ronald P	Warrick, Noreen D		Correspondence to counsel regarding testing during the prosecution of the patents-in-suit requesting legal advice and providing information in order to obtain legal advice	AC
652	1	01/27/1995	Markovich, Ronald P	Warrick, Noreen D		Correspondence to counsel regarding testing during the prosecution of the patents-in-suit requesting legal advice and providing information in order to obtain legal advice	AC
653	1	01/27/1995	Markovich, Ronald P	Warrick, Noreen D		Draft of correspondence to counsel regarding testing during the prosecution of the patents-in-suit requesting legal advice and providing information in order to obtain legal advice	AC
654	2		Markovich, Ronald P			Removed and produced	
655	1		Markovich, Ronald P			Removed and produced	
656	2	12/16/1994	Markovich, Ronald P			Information reflecting attorney-client communications with O. McKinney regarding legal services related to patentability	AC
657	1		Markovich, Ronald P			Removed and produced	
658	2		Markovich, Ronald P			Removed and produced	

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
659	1		Markovich, Ronald P			Removed and produced	
660	2		Markovich, Ronald P			Removed and produced	
661	1		Markovich, Ronald P			Removed and produced	
662	1		Markovich, Ronald P			Removed and produced	
663	1		Markovich, Ronald P			Removed and produced	
664	2		Markovich, Ronald P			Removed and produced	
665	2		Markovich, Ronald P			Removed and produced	
666	3		Markovich, Ronald P			Removed and produced	
667	69		Markovich, Ronald P			Removed and produced	
668	69		Markovich, Ronald P			Removed and produced	
669	1		Markovich, Ronald P			Removed and produced	
670	1		Markovich, Ronald P			Removed and produced	
671	1		Markovich, Ronald P			Removed and produced	
672	37	08/1995	Markovich, Ronald P			Removed and produced	
673	43	08/1995	Markovich, Ronald P			Removed and produced	
674	38	08/1995	Markovich, Ronald P			Removed and produced	
675	37	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
676	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
677	36	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
678	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
679	43	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
680	42	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
681	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
682	41	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
683	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
684	32	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
685	32	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
686	32	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
687	20		Markovich, Ronald P			Removed and produced	
688	19		Markovich, Ronald P			Removed and produced	
689	66	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
690	47	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
691	54	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
692	54	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
693	67	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
694	37	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
695	43	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
696	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
697	37	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
698	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
699	36	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
700	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
701	43	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
702	42	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
703	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
704	41	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
705	38	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
706	69	07/1995 - 08/1995	Markovich, Ronald P			Removed and produced	
707	40		Markovich, Ronald P			Removed and produced	
708	2	10/21/1995	Markovich, Ronald P			Removed and produced	
709	1		Markovich, Ronald P			Removed and produced	
710	1		Markovich, Ronald P			Removed and produced	
711	1		Markovich, Ronald P			Removed and produced	
712	1		Markovich, Ronald P			Removed and produced	
713	2	01/25/1995	Markovich, Ronald P			Removed and produced	
714	2	01/25/1995	Markovich, Ronald P			Removed and produced	
715	2	01/26/1995	Markovich, Ronald P			Removed and produced	
716	2	01/26/1995	Markovich, Ronald P			Removed and produced	
717	2	10/12/1995	Markovich, Ronald P			Removed and produced	
718	2	01/25/1995	Markovich, Ronald P			Removed and produced	
719	2	01/25/1995	Markovich, Ronald P			Removed and produced	
720	2	01/25/1995	Markovich, Ronald P			Removed and produced	
721	2	01/25/1995	Markovich, Ronald P			Removed and produced	
722	2	10/12/1995	Markovich, Ronald P			Removed and produced	
723	2	01/26/1995	Markovich, Ronald P			Removed and produced	
724	2	01/25/1995	Markovich, Ronald P			Removed and produced	
725	2	01/25/1995	Markovich, Ronald P			Removed and produced	
726	1	01/26/1995	Markovich, Ronald P			Removed and produced	
727	1	01/26/1995	Markovich, Ronald P			Removed and produced	
728	1	01/26/1995	Markovich, Ronald P			Removed and produced	
729	1	01/25/1995	Markovich, Ronald P			Removed and produced	
730	1	01/25/1995	Markovich, Ronald P			Removed and produced	
731	19	01/26/1994	Markovich, Ronald P			Prior art search performed at the request of Dow legal department	AC
732	55	01/26/1994	Markovich, Ronald P			Prior art search performed at the request of Dow legal department	AC
733	1	08/22/2003	Johnson, Mark S	Hazlitt, Lonnie		Handwritten notes requesting information on behalf of S. Krupp in order to obtain legal advice	AC
734	27	10/04/2005	Balke, Stephen T			Draft report on testing and infringement analysis performed at the request of G. Porter and H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
735	1	03/2006 - 04/2006	Johnson, Mark S	Hazlitt, Lonnie		Handwritten note regarding testing performed at the request of H. Roper in anticipation of litigation	WP
736	1	04/2006 - 06/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
737	4	01/14/2005	Johnson, Mark S	Hazlitt, Lonnie		Testing performed and analyzed at the request of H. Roper in anticipation of litigation	WP
738	12	03/02/2006	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
739	6	04/2006 - 06/2006	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
740	1		Johnson, Mark S			Folder containing testing performed at the request of counsel in anticipation of litigation	WP
741	1	08/23/2004	Reichek, Ken; Johnson, Mark S			Testing performed at the request of G. Porter in anticipation of litigation	WP
742	1	10/05/2004	Johnson, Mark S	Reichek, Ken		Handwritten notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
743	2	10/19/2004		Reichek, Ken; Johnson, Mark S		Lab results with handwritten notes of testing performed at the request of G. Porter in anticipation of litigation	WP
744	1	08/31/2004		Reichek, Ken; Johnson, Mark S		Lab results of testing performed at the request of G. Porter in anticipation of litigation	WP
745	1	08/27/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
746	1	08/27/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
747	3	08/27/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
748	2	08/27/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
749	3	08/26/2004 - 9/22/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
750	3	08/23/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
751	2	08/25/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
752	1	09/10/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
753	1	09/10/2004	Johnson, Mark S	Reichek, Ken		Handwritten notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
754	2	09/14/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
755	3	09/14/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
756	2	09/13/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
757	1	08/30/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
758	3	09/03/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
759	1	09/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
760	3	09/03/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
761	2	09/03/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
762	4	09/04/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
763	1	10/27/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
764	3	10/30/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
765	2	10/30/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
766	1	10/30/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
767	2	10/30/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
768	1	11/03/2003	Hazlitt, Lonnie	Reichek, Ken; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
769	3	10/27/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
770	2	10/29/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
771	2	10/27/2003	Johnson, Mark S			Handwritten notes regarding fractionation testing performed at the request of M. Glenn in anticipation of litigation	WP
772	1	10/27/2003	Johnson, Mark S			Handwritten notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
773	3	10/27/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
774	1	11/07/2003	Reichek, Ken; Johnson, Mark S			Testing performed at the request of M. Glenn in anticipation of litigation	WP
775	1	11/12/2003	Hazlitt, Lonnie	Johnson, Mark S		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
776	3	11/12/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
777	2	11/10/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
778	3	11/10/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
779	1	11/07/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
780	1	2/2004	Johnson, Mark S			Notes regarding fraction testing performed at the request of G. Porter in anticipation of litigation	WP
781	6	02/19/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
782	2	10/27/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
783	2	10/29/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
784	1	09/21/2004	Johnson, Mark S			Handwritten notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
785	2	09/26/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
786	10	09/29/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
787	1	2004		Johnson, Mark S		Lab results with handwritten notes of testing performed at the request of G. Porter in anticipation of litigation	WP
788	3	09/14/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
789	2	09/24/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
790	2	09/23/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
791	1	11/12/2003		Johnson, Mark S		Handwritten notes regarding polymer testing performed at the request of M. Glenn in anticipation of litigation	WP
792	2	12/20/2003		Johnson, Mark S		Handwritten notes regarding polymer testing performed at the request of M. Glenn in anticipation of litigation	WP
793	3	01/07/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
794	1	01/07/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
795	3	01/08/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
796	1	01/08/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
797	8	12/04/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
798	1	12/07/2003	Reichek, Ken	Johnson, Mark S		Handwritten notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
799	1	12/07/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
800	2	01/06/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
801	4	11/24/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
802	1	11/24/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
803	2	12/19/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
804	1	11/22/2003	Johnson, Mark S			Handwritten notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
805	6	11/22/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
806	4	11/14/2003	Hazlitt, Lonnie; Johnson, Mark S	Johnson, Mark S; Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
807	2	12/19/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
808	3	11/28/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
809	3	11/22/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
810	2	11/19/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
811	2	11/18/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
812	2	11/18/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
813	3	11/17/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
814	2	11/15/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
815	2	11/14/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
816	2	11/14/2003		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
817	4	09/09/2003	Johnson, Mark S			Report regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
818	1	11/10/2003	Johnson, Mark S			Handwritten notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
819	1	10/27/2003	Reichek, Ken	Johnson, Mark S		Lab results of testing performed at the request of M. Glenn in anticipation of litigation	WP
820	7	10/27/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
821	1	08/18/2003	Johnson, Mark S	Turk, Thelma; Dekunder, Staci; Fordyce, William; Niemann, Debra; Ramsey, David; Hazlitt, Lonnie; McConnell, Dennis; Krupp, Stephen; Story, Bruce; Johnson, Mark S; Kolthammer, Brian WS; Anderson, Kenneth W; Crim, Brad; Sehanobish, Kalyan; Cobler, Brad; Dowling, Nicole; Koch, Kaeyln; Wooster, Jeffrey J; deGroot, A Willem; Gillespie, David; Karjala, Teresa; Bernier, Robert; Eversdyk, David; Jain, Pradeep		Redaction: E-mail correspondence reflecting attorney-client privileged communication with S. Krupp, Esq. (Removed and produced)	AC
822	5		Peters, Herbert			Removed and produced	
823	1	10/23/2003	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of M. Glenn in anticipation of litigation	WP
824	12	09/09/2003	Johnson, Mark S			Report regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
825	11	09/09/2003	Johnson, Mark S			Report regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
826	1	09/10/2003	Johnson, Mark S	Reichek, Ken		Handwritten note regarding testing performed at the request of M. Glenn in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
827	1	11/20/2003	Johnson, Mark S	Reichek, Ken		Handwritten notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
828	3	09/16/2003	Johnson, Mark S			Handwritten notes and lab results regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
829	1					Removed and produced	
830	1					Removed and produced	
831	1	09/04/2003	Johnson, Mark S			Testing performed at the request of M. Glenn in anticipation of litigation	WP
832	1	09/03/2003	Johnson, Mark S	Reichek, Ken		Handwritten notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
833	2	10/02/2003	Johnson, Mark S			Notes and correspondence regarding work performed at the request of M. Glenn in anticipation of litigation	WP
834	3	09/09/2003	Johnson, Mark S			Report regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
835	15	08/22/2003	Johnson, Mark S			Handwritten notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
836	3	09/09/2003	Johnson, Mark S			Report with handwritten notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
837	2	09/02/2003	Dekunder, Staci	Johnson, Mark S; Niemann, Debra; Hazlitt, Lonnie; Anderson, Kenneth W; Crim, Brad; Sehanobish, Kalyan; Jain, Pradeep		E-mail correspondence regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
838	1					Removed and produced	
839	1	09/02/2003	Johnson, Mark S			Notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
840	2	09/02/2003	Johnson, Mark S			Notes regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
841	9	09/04/2003	Johnson, Mark S			Notes regarding and documents regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
842	9	08/18/2003	Johnson, Mark S			Presentation slides with handwritten notes regarding analysis and testing performed at the request of S. Krupp in anticipation of litigation	WP
843	20	08/18/2003	Johnson, Mark S			Presentation regarding testing and analysis performed at the request of M. Glenn in anticipation of litigation	WP
844	15	08/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
845	1	09/10/2003 - 09/23/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
846	2	09/10/2003 - 09/23/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
847	30	11/03/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
848	22	10/10/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
849	22	10/11/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
850	22	10/20/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
851	1	10/09/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
852	1	10/09/2003	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
853	26	10/09/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
854	1	09/16/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
855	1	10/10/2003	Nelson, Mike	Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Williams, Allen	Gillespie, David	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
856	26	10/09/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
857	3	09/23/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
858	23	09/23/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
859	34	10/06/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
860	33	10/08/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
861	1	08/28/2003	Johnson, Mark S	Reichek, Ken		Correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
862	1	08/27/2003	Johnson, Mark S	Stevens, James		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
863	1	05/2004	Johnson, Mark S			Folder containing analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
864	3	05/19/2004	Johnson, Mark S			Correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
865	2	05/21/2004	Johnson, Mark S	Reichek, Ken		Correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
866	2	03/18/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
867	3	05/14/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
868	3	05/15/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
869	2	05/27/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
870	7	05/14/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
871	30	05/15/2005		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
872	70	05/19/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
873	30	05/14/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
874	70	05/14/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
875	103	05/27/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
876	1	03/13/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
877	3	03/13/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
878	57	03/19/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
879	2	05/04/2004	Johnson, Mark S			Notes regarding testing and work to be performed at the request of G. Porter in anticipation of litigation	WP
880	1	04/05/2004	Johnson, Mark S			Notes regarding testing and work to be performed at the request of G. Porter in anticipation of litigation	WP
881	1	05/05/2004	Johnson, Mark S	Reichek, Ken		Correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
882	1	05/05/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
883	1	04/07/2004	Johnson, Mark S	Glenn, Michael L; Kanuch, Bruce M	Fordyce, William; Story, Bruce; Krupp, Stephen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
884	1	04/07/2004	Johnson, Mark S	Reichek, Ken	Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
885	4	04/07/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
886	1	03/31/2004	Johnson, Mark S			Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
887	2	03/25/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
888	1	03/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
889	3	03/18/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
890	2	03/17/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
891	2	03/2004 - 04/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
892	3	03/25/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
893	2	03/23/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
894	3	03/25/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
895	1	03/22/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
896	1	03/24/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
897	6	11/07/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
898	1	03/17/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
899	30	03/17/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
900	34	03/19/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
901	34	03/25/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
902	3	07/26/2004				Removed and produced	
903	5	04/30/2004				Removed and produced	

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904	2	07/18/2003	Johnson, Mark S	Anderson, Kenneth W; Crim, Brad; Dekunder, Staci; Fordyce, William; Sehanobish, Kalyan; Cobler, Brad; Dowling, Nicole; Koch, Kaeyln; Niemann, Debra; Ramsey, David; Wooster, Jeffrey J; Degroot, Willem; Gillespie, David; Hazlitt, Lonnie; Karjala, Teresa; Bernier, Robert; Kolthammer, Brian W.S; Eversdyk, David; Jain, Pradeep; McConnell, Dennis; Krupp, Stephen; Story, Bruce		E-mail correspondence reflecting attorney-client privileged communication with S. Krupp, Esq.	AC
905	1	07/18/2003	Johnson, Mark S	Peters, Herbert	Dekunder, Staci; Neimann, Debra	Removed and produced	
906	2	07/16/2003	Johnson, Mark S			Removed and produced	
907	3	08/06/2003	Peters, Herbert			Removed and produced	
908	3	08/06/2003	Peters, Herbert			Removed and produced	
909	3	08/06/2003				Removed and produced	
910	3	07/29/2003	Peters, Herbert		Peters, Herbert	Removed and produced	
911	3	07/29/2003	Peters, Herbert		Peters, Herbert	Removed and produced	
912	3	07/29/2003	Peters, Herbert		Peters, Herbert	Removed and produced	
913	6	06/10/2004	Johnson, Mark S			Report regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
914	1	04/15/2004	Johnson, Mark S			Removed and produced	
915	1		Johnson, Mark S			Folder containing testing performed at the request of counsel in anticipation of litigation	WP
916	2	11/2004		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
917	8	11/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
918	1	10/11/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
919	1	10/04/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
920	1	09/27/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
921	1	09/20/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
922	1	09/13/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
923	1	09/06/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
924	1	08/30/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
925	5	07/24/2003, 10/29/2003, 11/10/2003, 08/27/2004, 01/19/2005		Johnson, Mark S		Testing performed at the request of G. Porter, H. Roper, and M. Glenn and compiled in anticipation of litigation	WP
926	2	08/23/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
927	2	08/16/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
928	1	08/09/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
929	1	08/02/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
930	1	07/25/2005	Johnson, Mark S	Balke, Stephen T; Trybus, Steven R;; Marinelli, Joseph F		E-mail correspondence with handwritten notes regarding testing performed at the request of H. Roper in anticipation of litigation	AC, WP
931	2	06/14/2005	Johnson, Mark S	Trybus, Steven R	Balke, Stephen T; Hazlitt, Lonnie; Reichek, Ken; Krupp, Stephen; Kanuch, Bruce M; Turk, Thelma	E-mail correspondence reflecting attorney-client privileged communications between M. Johnson and S. Trybus, Esq. regarding testing performed at the request of H. Roper and G. Porter in anticipation of litigation	AC, WP
932	1	07/05/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
933	2	05/31/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
934	2	05/17/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
935	2	05/10/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
936	1	04/29/2005	Trybus, Steven R	Roper, Harry J; Marinelli, Joseph F; Kanuch, Bruce M; Johnson, Mark S		E-mail correspondence reflecting attorney-client privileged communications regarding testing performed at the request of H. Roper in anticipation of litigation	AC
937	1	04/21/2005	McDaniel, T	Trybus, Steven R; Roper, Harry J; Marinelli, Joseph F; Kanuch, Bruce M; Johnson, Mark S	Erickson, A	E-mail correspondence regarding meeting to obtain legal advice and containing handwritten notes of M. Johnson regarding agenda prepared in anticipation of litigation	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
938	4	04/26/2005	Johnson, Mark S			Handwritten notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
939	1	04/29/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
940	5	04/29/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
941	1	04/26/2005	Johnson, Mark S			Handwritten notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
942	1	09/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
943	1	04/12/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
944	1	03/29/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
945	1	03/29/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
946	2	03/29/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
947	2	03/29/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
948	1	03/23/2005	Johnson, Mark S	Reichek, Ken		Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
949	1	03/30/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
950	1	03/30/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
951	1	03/30/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
952	1	12/01/2004		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP

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953	1	03/22/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
954	2	12/01/2004		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
955	1	03/15/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
956	1	03/08/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
957	1	03/01/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
958	1	02/22/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
959	1	02/08/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
960	1	01/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
961	2	01/18/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
962	2	01/11/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
963	4	12/2004		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
964	4	02/01/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
965	1	12/2004				Testing performed at the request of H. Roper in anticipation of litigation	WP
966	1	08/23/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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967	2	01/25/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
968	1	01/04/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
969	2	12/20/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
970	2	12/13/2004	Hazlitt, Lonnie	Johnson, Mark S	Turk, Thelma; Reichek, Ken; Williams, Allen; Balke, Stephen T	E-mail correspondence regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
971	1	12/06/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
972	1	11/29/2004	Johnson, Mark S	Reichek, Ken		Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
973	2	11/29/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
974	2	11/22/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
975	2	11/15/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
976	4	11/01/2004		Johnson, Mark S		Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
977	13	10/29/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
978	1	10/25/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
979	1	10/25/2004	Johnson, Mark S			Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
980	1	10/05/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
981	1	10/22/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
982	1	10/19/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
983	1	10/18/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
984	2	10/11/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
985	2	10/07/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
986	4	09/27/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
987	2	09/01/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
988	1	09/01/2004	Johnson, Mark S	Krupp, Stephen; Balke, Stephen T; Porter, Greg; Hazlitt, Lonnie		E-mail correspondence regarding meeting with counsel and expert analyst to discuss infringement analysis	AC
989	1	08/02/2004	Johnson, Mark S			Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
990	1	08/19/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
991	1	08/16/2004	Johnson, Mark S			Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
992	18	05/25/2005	Johnson, Mark S			Presentation regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
993	5	08/2005				Simulation performed at the request of H. Roper in anticipation of litigation	WP
994	1	04/13/2005	Kanuch, Bruce M	Schwartz, Roger		Letter from counsel providing legal advice regarding patent infringement	AC
995	1	04/2005	Kanuch, Bruce M	Schwartz, Roger; Johnson, Mark S		Draft presentation slide reflecting attorney-client privileged communications regarding patent infringement	AC
996	1	05/02/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
997	2	05/02/2005		Johnson, Mark S		Testing compiled at the request of H. Roper in anticipation of litigation	WP
998	1	05/13/2005	Johnson, Mark S			Slide from presentation prepared at the request of H. Roper in anticipation of litigation	WP
999	1	05/13/2005	Johnson, Mark S			Slide from presentation prepared at the request of H. Roper in anticipation of litigation	WP
1000	2	05/02/2005				Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1001	1	04/19/2005	Johnson, Mark S	Kanuch, Bruce M	Krupp, Stephen; Hazlitt, Lonnie	E-mail correspondence providing attached reports to Dow attorneys B. Kanuch and S. Krupp in order to obtain legal advice in anticipation of litigation	AC, WP
1002	1	04/18/2005	Johnson, Mark S	Kanuch, Bruce M	Krupp, Stephen; Hazlitt, Lonnie	Attached notes regarding analysis of reports performed at the request of H. Roper in anticipation of litigation provided to Dow attorneys B. Kanuch and S. Krupp in order to obtain legal advice	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1003	1	04/18/2005	Johnson, Mark S	Kanuch, Bruce M	Krupp, Stephen; Hazlitt, Lonnie	Attached notes regarding analysis of reports performed at the request of H. Roper in anticipation of litigation provided to Dow attorneys B. Kanuch and S. Krupp in order to obtain legal advice	AC, WP
1004	1		Johnson, Mark S			Handwritten notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1005	1	04/14/2005	Kanuch, Bruce M	Schwartz, Roger	Glenn, Michael; Johnson, Mark S	E-mail correspondence providing legal advice regarding patent infringement and forwarding attorney-client communications	AC
1006	2	04/13/2005	Kanuch, Bruce M	Schwartz, Roger		Letter providing legal advice regarding patent infringement	AC
1007	1	04/14/2005	Johnson, Mark S	Kanuch, Bruce M	Krupp, Stephen	Attached e-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1008	1	04/19/2005	Johnson, Mark S	Schwartz, Roger	Kanuch, Bruce M; Glenn, Michael; Hays, Michael; McAlindon, Julie; Krupp, Stephen; Story, Bruce	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation and reflecting attorney-client communications with Dow Legal Dept	AC, WP
1009	1	05/25/2005	Fordyce, William	Glenn, Michael L	Swogger, Kurt W; Schwartz, Roger; Story, Bruce; Johnson, Mark S	E-mail correspondence regarding infringement analysis reflecting attorney-client privileged communications between W. Fordyce and M. Glenn, Esq.	AC
1010	2	05/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1011	2	05/2005		Johnson, Mark S		Testing analyzed at the request of H. Roper in anticipation of litigation	WP
1012	2	05/13/2005	Johnson, Mark S			Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1013	1					Removed and produced	
1014	1	05/19/2005	Johnson, Mark S	Turk, Thelma; Johnson, Mark S; Fordyce, William; Kanuch, Bruce M; Story, Bruce; Roper, Harry J		E-mail correspondence regarding meeting to request legal advice	AC
1015	1	05/17/2005	Johnson, Mark S	Johnson, Mark S; Kanuch, Bruce M; Roper, Harry J; Trybus, Steven R; Barlow, Aaron A		E-mail correspondence regarding meeting to request legal advice	AC
1016	1	05/16/2005	Johnson, Mark S	Kanuch, Bruce M; Roper, Harry J; Trybus, Steven R		E-mail regarding analysis provided at the request of H. Roper in anticipation of litigation and reflecting attorney-client communications with B. Kanuch, Esq.	AC, WP
1017	1	05/13/2005 - 05/16/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1018	1	05/13/2005	Johnson, Mark S	Turk, Thelma; Johnson, Mark S; Fordyce, William; Story, Bruce; Hazlitt, Lonnie; Kolthammer, Brian WS; Chum, Stephen; Glenn, Michael L; Kanuch, Bruce M; Krupp, Stephen		E-mail requesting legal advice regarding patent enforcement	AC
1019	1	05/13/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1020	3	05/12/2005	Johnson, Mark S			Handwritten notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation and reflecting attorney-client privileged communications between M. Johnson, B. Kanuch, Esq. and M. Glenn, Esq.	AC, WP
1021	10	05/13/2005	Johnson, Mark S			Presentation regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1022	1	05/13/2005	Johnson, Mark S			Presentation slide regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1023	1	05/13/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1024	1	05/13/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1025	1	05/13/2005	Johnson, Mark S			Presentation regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1026	1	05/13/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1027	5	05/13/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1028	1	01/05/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1029	1	04/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1030	1	11/09/2004	Johnson, Mark S			Handwritten notes prepared at the request of G. Porter in anticipation of litigation	WP
1031	3	11/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1032	6	11/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1033	5	11/01/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1034	1	11/01/2004		Johnson, Mark S		Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1035	2	11/01/2004	Johnson, Mark S			Report regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1036	1					Removed and produced	
1037	1	11/01/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1038	31	11/10/2004	Johnson, Mark S			Presentation regarding analysis of testing performed at the request of G. Porter in anticipation of litigation	WP
1039	1	05/03/2004	Johnson, Mark S; Krupp, Stephen; Glenn, Michael L			Presentation regarding analysis performed at the request of G. Porter in anticipation of litigation in order to obtain legal advice	AC, WP
1040	4	04/08/2005 - 04/19/2005	Johnson, Mark S			Handwritten notes reflecting attorney-client communications with B. Kanuch and documenting testing prepared at the request of H. Roper in anticipation of litigation	AC, WP
1041	3	11/01/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1042	5	04/14/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1043	17					Removed and produced	
1044	2	04/18/2005	Johnson, Mark S			Handwritten notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1045	4	04/12/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1046	1	04/08/2005	Wamback, Annmarie	Turk, Thelma; Johnson, Mark S; Schwartz, Roger; Glenn, Michael L; Fordyce, William; Story, Bruce; Krupp, Stephen; Kanuch, Bruce M; Glenn, Michael		Meeting notice sent to request legal advice	AC
1047	3	04/07/2005	Johnson, Mark S			Handwritten notes reflecting preparation for meeting to discuss infringement analysis in anticipation of litigation and reflecting attorney-client communications between M. Johnson, B. Kanuch, Esq., and M. Glenn, Esq.	AC, WP

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1048	12	04/08/2005	Johnson, Mark S			Presentation regarding analysis of testing performed at the request of H. Roper in anticipation of litigation	WP
1049	1	02/07/2005	Johnson, Mark S			Analysis performed at the request of H. Roper in anticipation of litigation	WP
1050	1	04/04/2005	Johnson, Mark S			Notes containing information collected at the request of H. Roper in anticipation of litigation	WP
1051	2	04/18/2005	Kanuch, Bruce M	Roper, Harry J	Johnson, Mark S	E-mail correspondence regarding status of foreign patent applications and reflecting legal advice of outside counsel on foreign prosecution strategy	AC
1052	3	04/11/2005	Kanuch, Bruce M			Report regarding infringement prepared by counsel in anticipation of litigation	WP
1053	1	04/04/2005	Johnson, Mark S			Notes reflecting analysis and testing performed at the request of H. Roper in anticipation of litigation and reflecting attorney-client communications with S. Krupp	AC, WP
1054	3	04/11/2005	Kanuch, Bruce M			Report regarding infringement prepared by counsel in anticipation of litigation	WP
1055	1	03/31/2005	Wooster, Jeffrey J	Johnson, Mark S		E-mail correspondence regarding analysis performed at the request of the Dow legal department in anticipation of litigation	WP
1056	1	01/30/2005		Johnson, Mark S		Modeling performed at the request of H. Roper in anticipation of litigation	WP
1057	1	11/04/2004	Johnson, Mark S			CD cover containing information prepared at the request of G. Porter in anticipation of litigation	WP
1058	1	11/10/2004	Johnson, Mark S			Handwritten notes referencing analysis performed at the request of H. Roper in anticipation of litigation	WP
1059	41	01/30/2005		Johnson, Mark S		Presentation regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1060	1	09/23/2004	Johnson, Mark S			Notes regarding testing and analysis performed at the request of G. Porter in anticipation of litigation	WP
1061	2	06/03/2004	Johnson, Mark S			Handwritten notes regarding testing performed at the request of G. Porter in anticipation of litigation and collecting information to provide to G. Porter in order to obtain legal advice	AC, WP
1062	1	01/19/2004	Johnson, Mark S			Handwritten notes regarding plans for testing and other work performed at the request of G. Porter in anticipation of litigation and reflecting attorney-client communications with G. Porter	AC, WP
1063	2	01/19/2004	Johnson, Mark S	Boulware, Meg; Israel, Sharon; Porter, Greg; Selinger, Jerry; Glenn, Michael L; Krupp, Stephen; Story, Bruce; Williams, Allen; Reichek, Ken; Hazlitt, Lonnie		Meeting agenda and notes regarding infringement analysis prepared in anticipation of litigation and reflecting attorney-client communications with G. Porter	AC, WP
1064	1	05/2004	Johnson, Mark S			Handwritten notes referencing analysis performed at the request of G. Porter in anticipation of litigation	WP
1065	16	05/03/2004	Johnson, Mark S; Krupp, Stephen; Glenn, Michael L			Draft presentation regarding analysis of testing performed at the request of G. Porter in anticipation of litigation and presenting legal advice from Dow attorneys M. Glenn and S. Krupp	AC, WP
1066	40	01/19/2004	Krupp, Stephen			Presentation prepared by counsel providing legal analysis and strategy for testing in anticipation of litigation and providing information in order to obtain legal advice	AC, WP
1067	3	04/04/2005	Hays, Michael	Johnson, Mark S		E-mail correspondence regarding analysis performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1068	2	02/24/2005	Johnson, Mark S			Notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1069	5	02/24/2005		Johnson, Mark S		Analysis performed at the request of H. Roper in anticipation of litigation	WP
1070	1	01/30/2005		Johnson, Mark S		Modeling performed at the request of H. Roper in anticipation of litigation	WP
1071	1	02/04/2005	Johnson, Mark S			Notes prepared in anticipation of litigation regarding infringement analysis and reflecting attorney-client privileged communications with B. Kanuch, Esq. and H. Roper, Esq.	AC, WP
1072	1	02/08/2005	Johnson, Mark S			Notes regarding analysis of testing performed at the request of H. Roper in anticipation of litigation	WP
1073	1	02/11/2005	Johnson, Mark S			Notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1074	1	02/08/2005	Johnson, Mark S			Handwritten notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation and reflecting attorney-client communications with H. Roper	AC, WP
1075	1	02/16/2005	Johnson, Mark S			Analysis performed at the request of H. Roper in anticipation of litigation	WP
1076	4	02/03/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1077	19	02/16/2005	Johnson, Mark S			Presentation regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1078	4	02/16/2005	Johnson, Mark S			Presentation regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1079	62	01/2004 - 11/2004	Porter, Greg	Johnson, Mark S		Infringement analysis prepared by counsel in anticipation of litigation providing legal advice regarding patents-in-suit	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1080	14	09/23/2004	Johnson, Mark S			Copy of patent-in-suit with handwritten notes reflecting analysis prepared by Mark Johnson at the request of G. Porter in anticipation of litigation	WP
1081	13	09/23/2004	Johnson, Mark S			Copy of patent-in-suit with handwritten notes reflecting analysis prepared by Mark Johnson at the request of G. Porter in anticipation of litigation	WP
1082	1	09/23/2004	Johnson, Mark S			Notes regarding analysis performed at the request of G. Porter in anticipation of litigation	WP
1083	1		Johnson, Mark S			Notes regarding analysis prepared in anticipation of litigation	WP
1084	1	02/2004	Johnson, Mark S			Notes regarding analysis of patent for infringement at the request of G. Porter in anticipation of litigation	WP
1085	50					Attached patent analyzed at the request of G. Porter in anticipation of litigation	WP
1086	2		Johnson, Mark S			Copy of patent-in-suit with handwritten notes reflecting analysis performed at the request of counsel in anticipation of litigation	WP
1087	43	09/15/1992	Chum, Pak-Wing S; Markovich, Ronald P; Knight, George W; Lai, Shih-Yaw	Krupp, Stephen; White, L Wayne		Invention disclosure statement communicating to Dow legal department and S. Krupp the invention of the patents-in-suit in order to obtain legal advice	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1088	1	04/04/1995	Jozwiak, Greg	Korfhage, Glenn	Buss, Jerry; Chum, Stephen; Jain, Pradeep; Kao, Che; Koch, Kaeyln; Lancaster, G.; McKinney, Ozborne K; Moyer, P.; Polemenakos, Steve; Story, Bruce; Torres, Tony; White, L Wayne; Williams, M.	Correspondence reflecting attorney-client privileged communications regarding patent strategy	AC
1089	2	03/16/1995	Docking, Darrel	Chum, Stephen; Jain, Pradeep;; McKinney, Osborne K.; Volkenbugh, B.; Koch, Kaeyln; Polemenakos, Steve; Story, Bruce	Korfhage, Glenn; Torres, Tony; Buss, Jerry; Lancaster, G.; White, L Wayne; Kao, Che	Correspondence reflecting attorney-client communications regarding patenting strategy	AC
1090	1	03/03/1995	Docking, Darrel			Agenda of meeting scheduled in order to provide legal advice regarding patent position reflecting attorney-client communications with O. McKinney	AC
1091	4	03/03/1995	Docking, Darrel			Attached presentation slides reflecting attorney-client privileged communications with Dow Legal Department regarding patent strategy	AC
1092	3	03/03/1995	Docking, Darrel			Outline prepared by attorney agent (D. Docking) reflecting attorney-client communications regarding Dow patent portfolio	AC
1093	2	03/03/1995	Docking, Darrel			Draft chart of prior art reflecting request for legal advice from Dow legal department regarding patentability	AC
1094	4	03/03/1995	Docking, Darrel			Draft chart of patent applications and application strategy prepared by attorney agent (D. Docking) reflecting attorney-client communications with Dow Legal Department	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1095	7	04/03/1996	Hazlitt, Lonnie	Roper, Harry J		Correspondence providing information to counsel in order to obtain legal advice regarding right to practice	AC
1096	29	02/17/1993	Krupp, Stephen			Draft patent application reflecting attorney-client communications between inventors and the Dow legal department	AC
1097	2	03/23/1995	Chum, Stephen	Krupp, Stephen		Correspondence to counsel providing information to counsel in order to obtain legal advice regarding patent prosecution	AC
1098	1	04/08/1993	Markovich, Ronald P	Krupp, Stephen		Cover sheet of fax correspondence providing information to counsel in order to obtain legal advice regarding patent prosecution	AC
1099	1	04/08/1993	Markovich, Ronald P	Krupp, Stephen		Testing provided to counsel in order to obtain legal advice regarding patent prosecution	AC
1100	1	04/08/1993	Markovich, Ronald P	Krupp, Stephen		Technical information provided to counsel in order to obtain legal advice regarding patent prosecution	AC
1101	1	04/08/1993	Markovich, Ronald P	Krupp, Stephen		Receipt of fax correspondence providing information to counsel in order to obtain legal advice regarding patent prosecution	AC
1102	3	04/22/1993	Krupp, Stephen	Greene, Margaret		Internal correspondence reflecting legal advice of counsel regarding prosecution of patent	AC
1103	2	04/22/1993	Krupp, Stephen	Greene, Margaret		Internal correspondence reflecting legal advice of counsel regarding prosecution of patent	AC
1104	1	04/12/1993	Markovich, Ronald P	Krupp, Stephen		Cover sheet of fax correspondence providing information to counsel in order to obtain legal advice regarding patent prosecution	AC
1105	1	04/12/1993	Markovich, Ronald P	Krupp, Stephen		Technical data provided to Dow legal department in order to obtain legal advice regarding patent prosecution	AC

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1106	1	04/12/1993	Markovich, Ronald P	Krupp, Stephen		Technical data provided to Dow legal department in order to obtain legal advice regarding patent prosecution	AC
1107	37	04/1993	Krupp, Stephen			Draft patent application reflecting attorney-client communications between inventors and the Dow legal department	AC
1108	1		Johnson, Mark S			Folder containing analysis and testing performed at the request of counsel in anticipation of litigation	WP
1109	2	01/30/2005		Johnson, Mark S		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1110	7	01/06/2005	Johnson, Mark S			Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1111	2	01/11/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1112	1	12/21/2004		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1113	6	12/21/2004		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1114	6	01/10/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1115	24	01/10/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1116	6	01/07/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1117	12	01/07/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1118	3	01/05/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1119	14	01/05/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1120	1	01/04/2005	Johnson, Mark S	Reichek, Ken		Note correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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1121	3	01/04/2005		Johnson, Mark S		Testing collected, organized and analyzed at the request of H. Roper in anticipation of litigation	WP
1122	7	01/04/2005		Johnson, Mark S		Testing collected, organized and analyzed at the request of H. Roper in anticipation of litigation	WP
1123	4	01/14/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1124	3	12/13/2004	Kanuch, Bruce M	Johnson, Mark S; Roper, Harry J;		E-mail correspondence reflecting attorney-client privileged communications and providing information in order to obtain legal advice and handwritten notes of M. Johnson regarding work performed at the request of H. Roper in anticipation of litigation	AC, WP
1125	1	01/05/2005		Johnson, Mark S		Report with handwritten notes of M. Johnson regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1126	6	12/13/2004	Gillespie, David; Oswald, Tom	Johnson, Mark S		Presentation regarding testing and modeling performed at the request of H. Roper in anticipation of litigation	WP
1127	2	11/18/2004		Johnson, Mark S		Testing collected, organized and analyzed with handwritten notes of M. Johnson at the request of H. Roper in anticipation of litigation	WP
1128	1	11/18/2004		Johnson, Mark S		Testing collected, organized and analyzed at the request of H. Roper in anticipation of litigation	WP
1129	1	01/11/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1130	1	01/11/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1131	6	01/06/2005	Johnson, Mark S			Analysis of test results performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1132	1	01/11/2005		Johnson, Mark S		Testing performed and results compiled in anticipation of litigation and containing notes of M. Johnson analyzing the testing at the request of H. Roper	WP
1133	1	01/11/2005	Johnson, Mark S	Reichek, Ken		Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1134	7	06/01/2004	Johnson, Mark S			Testing performed and results compiled in anticipation of litigation and containing notes of M. Johnson analyzing the testing at the request of H. Roper	WP
1135	2	06/01/2004	Johnson, Mark S			Testing performed at the request of G. Porter in anticipation of litigation and containing notes of M. Johnson analyzing the testing at the request of H. Roper	WP
1136	1	01/17/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1137	1	01/17/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1138	1	01/17/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1139	1	01/16/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1140	2	01/21/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1141	1	01/21/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1142	2	01/19/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1143	4	01/21/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1144	1	02/01/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1145	2	01/18/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1146	1	02/01/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1147	2	02/01/2005	Reichek, Ken	Johnson, Mark S		Handwritten notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1148	2	12/06/2004	Johnson, Mark S	Kanuch, Bruce M; Roper, Harry J		E-mail correspondence requesting legal advice regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	AC, WP
1149	2	11/10/2004	Johnson, Mark S			Notes reflecting attorney-client communications with B. Kanuch, S. Trybus, H. Roper, and S. Krupp and regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	AC, WP
1150	1	11/04/2004	Johnson, Mark S			Notes reflecting attorney-client communications with H. Roper, A. Barlow, and R. Nimrod regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	AC, WP
1151	1	2005	Johnson, Mark S			Folder cover containing testing prepared at the request of H. Roper in anticipation of litigation	WP
1152	3	2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1153	1	2005	Johnson, Mark S			Handwritten notes regarding reports collected in anticipation of litigation	WP
1154	33	08/06/1997	Krupp, Stephen	McKinney, Ozborne K		Communication providing CRI report to counsel in order to obtain legal advice regarding patent prosecution	AC
1155	6	06/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1156	1	07/12/2004		Johnson, Mark S		Testing prepared at the request of G. Porter in anticipation of litigation	WP
1157	1	06/13/2004	Reichek, Ken	Johnson, Mark S; Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1158	1	09/09/2004	Johnson, Mark S			Note regarding analysis performed at the request of G. Porter in anticipation of litigation	WP
1159	1	07/15/2004	Johnson, Mark S	Reichek, Ken		Note regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1160	2	06/21/2004	Johnson, Mark S			Notes of analysis performed at the request of G. Porter in anticipation of litigation	WP
1161	2	09/24/2003	Johnson, Mark S			Notes of analysis performed at the request of G. Porter in anticipation of litigation	WP
1162	2	09/24/2003	Johnson, Mark S			Notes of analysis performed at the request of G. Porter in anticipation of litigation	WP
1163	1		Markovich, Ronald P			Removed and produced	
1164	1		Markovich, Ronald P			Removed and produced	
1165	1		Markovich, Ronald P			Removed and produced	
1166	1					Removed and produced	
1167	5	04/21/2004				Index of CRI reports prepared at the request of G. Porter in anticipation of litigation	WP
1168	9					Removed as duplicate of report already produced	
1169	2	03/30/1999	Oswald, Thomas			Draft figure of patent application reflecting attorney-client communications with O. McKinney regarding patent prosecution	AC
1170	2	03/19/1999	McKinney, Ozborne K	Chum, Pak-Wing S; Jain, Pradeep; Hazlitt, Andrea; Oswald, Thomas; Swogger, Kurt W.	Carrington, Susan; Docking, Darrel; Krupp, Stephen; Lastovica, John; Story, Bruce	E-mail correspondence providing legal advice regarding patent prosecution	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1171	2	04/28/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1172	1	04/28/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1173	4	04/30/1999				Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1174	2	05/06/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1175	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of M. Glenn in anticipation of litigation	WP
1176	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1177	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1178	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1179	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1180	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1181	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1182	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1183	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1184	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1185	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1186	1	05/08/1999	Oswald, Thomas			Testing collected and organized at the request of in-house counsel in anticipation of litigation	WP
1187	1	2003	Johnson, Mark S			Handwritten notes regarding testing requested by counsel in anticipation of litigation	WP
1188	1	09/26/2003	Johnson, Mark S			Notes regarding analysis performed at the request of M. Glenn in anticipation of litigation	WP
1189	1	09/04/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1190	1	09/04/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1191	1	08/13/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1192	1	08/13/2003		Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1193	1			Johnson, Mark S		Handwritten notes regarding testing requested by M. Glenn in anticipation of litigation	WP
1194	2	03/29/1999	Oswald, Thomas			Removed because incomplete duplicate of Privilege Log doc. #2393	
1195	1	10/2004				Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1196	5	10/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1197	1	10/2004				Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1198	5	10/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
1199	1	10/2004				Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1200	5	10/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
1201	1	10/2004				Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1202	5	10/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
1203	1					Handwritten notes regarding references collected by B. Kanuch in anticipation of litigation	WP
1204	1					Handwritten notes regarding references collected at the request of counsel in anticipation of litigation	WP
1205	1	02/12/2004	Patel, Rajen; Chum, Stephen; Johnson, Mark S	Chum, Stephen; Johnson, Mark S; Lai, Shih-Yaw; Markovich, Ronald P; Sehanobish, Kalyan		E-mail correspondence seeking information and providing information regarding references at the request of G. Porter in anticipation of litigation	WP
1206	1	02/2004	Johnson, Mark S			Notes regarding search to be performed at the request of G. Porter in anticipation of litigation	WP
1207	1	02/2004	Johnson, Mark S			Notes regarding research to be performed at the request of G. Porter in anticipation of litigation	WP
1208	2	01/05/2005	Johnson, Mark S			Presentation and notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1209	1	08/15/2005	Johnson, Mark S	Zhou, Zhe	Taha, Angela; Conboy, Claire; Hazlitt, Lonnie; Coker, Wayne	E-mail correspondence regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1210	2	06/23/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1211	2	06/23/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1212	6	06/2004		Johnson, Mark S		Presentation regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1213	2	06/03/2005		Johnson, Mark S		Report with handwritten notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1214	5	05/19/2005	Sun, Kefu	Johnson, Mark S		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1215	5	05/24/2005	Zhou, Zhe; Green, Shayne; Conboy, Claire			Presentation regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1216	1	03/12/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1217	14	04/01/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1218	1	03/17/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1219	2	07/14/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1220	1	03/14/2005	Coker, Wayne	Johnson, Mark S		E-mail correspondence regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1221	1	03/04/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1222	1	03/04/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1223	3	03/02/2005	Hazlitt, Lonnie	Conboy, Claire; Johnson, Mark S		E-mail correspondence regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1224	3	03/01/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1225	2	02/28/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1226	1	03/03/2005	Johnson, Mark S	Reichek, Ken		Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1227	1	03/03/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1228	1	03/08/2005	Johnson, Mark S	Reichek, Ken		Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1229	1	03/04/2005	Johnson, Mark S	Conboy, Claire	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1230	1	10/25/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1231	3	01/26/2005	Crown, Alechia	Zhou, Zhe; Conboy, Claire; Johnson, Mark S; Taha, Angela; Green, Shayne		E-mail correspondence regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1232	1	01/03/2005	Johnson, Mark S	Green, Shayne; Taha, Angela; Conboy, Claire; Crown, Alechia		E-mail correspondence regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1233	1	01/03/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1234	1	11/01/2004	Johnson, Mark S	Reichek, Ken		Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1235	1	10/27/2004	Johnson, Mark S	Reichek, Ken		Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1236	2	10/19/2004	Johnson, Mark S			Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1237	1	10/21/2004	Johnson, Mark S			Notes regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1238	1	10/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1239	2	10/12/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1240	6	07/13/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1241	8	10/05/2004		Johnson, Mark S		Presentation regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1242	2	10/05/2004 - 10/12/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1243	1	10/05/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1244	8	10/12/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1245	2	10/15/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1246	1	10/05/2004	Coker, Wayne	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1247	1	10/13/2004	Johnson, Mark S	Coker, Wayne		E-mail correspondence regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1248	1	10/08/2004		Johnson, Mark S		Report regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1249	1	10/12/2004	Johnson, Mark S	Reichek, Ken		Note regarding testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1250	1	10/05/2004	Coker, Wayne	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1251	1	10/05/2004	Johnson, Mark S	Reichek, Ken		Note regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1252	1	10/01/2004	Johnson, Mark S			Note regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1253	5	08/27/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1254	1	08/24/2004	Coker, Wayne	Hazlitt, Lonnie	Williams, Allen; Coker, Wayne; Johnson, Mark S	E-mail correspondence regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1255	5	06/01/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1256	4	08/23/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1257	2	08/26/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1258	2	08/23/2004	Johnson, Mark S	Reichek, Ken		Correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1259	1	07/26/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1260	4	10/27/2003	Reichek, Ken	Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1261	2	07/15/2004	Johnson, Mark S	Reichek, Ken		Note regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1262	2	08/20/2004	Taha, Angela	Johnson, Mark S; Reichek, Ken		Report regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1263	1	07/13/2004	Johnson, Mark S			Note regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP

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1264	1	07/13/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1265	2	06/21/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1266	1	06/14/2004	Johnson, Mark S	Reichek, Ken		Note regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1267	1	06/16/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1268	1	06/16/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1269	3	06/2004 - 07/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1270	7	06/03/1992				Removed and produced	
1271	49	08/23/2003	Reichek, Ken			Lab notebook documenting testing performed at the request of M. Glenn in anticipation of litigation	WP
1272	74	03/09/2005	Reichek, Ken			Lab notebook documenting testing performed at the request of H. Roper in anticipation of litigation	WP
1273	1		Johnson, Mark S			Folder containing testing performed at the request of counsel in anticipation of litigation	WP
1274	1					Removed and produced	
1275	1					Removed and produced	
1276	1					Removed and produced	
1277	1					Removed and produced	
1278	1	01/14/2005		Johnson, Mark S		Testing performed and compiled at the request of H. Roper in anticipation of litigation	WP
1279	1	09/04/2003	Reichek, Ken	Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1280	1	01/15/2005	Reichek, Ken	Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1281	1	01/15/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1282	1	01/26/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP

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1283	1	01/26/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1284	3	01/26/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1285	2	01/26/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1286	3	01/26/2005		Johnson, Mark S		Testing performed and analyzed at the request of H. Roper in anticipation of litigation	WP
1287	1	01/24/2005	Achten, Lisa	Jones, Laura		Report regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1288	1	01/21/2005	Potter, Janece	Jones, Laura		Report regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1289	8	01/17/2005		Johnson, Mark S		Report regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1290	1	12/06/2004	Johnson, Mark S			Handwritten notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1291	1	12/06/2004	Johnson, Mark S			Handwritten notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1292	1	05/16/2003	Johnson, Mark S			Removed and produced	
1293	1	05/30/2003	Johnson, Mark S; Ramsey, David			Removed and produced	
1294	1	05/30/2003	Johnson, Mark S; Ramsey, David			Removed and produced	
1295	1	05/30/2003	Johnson, Mark S; Ramsey, David			Removed and produced	
1296	1					Removed and produced	
1297	1					Removed and produced	
1298	18	09/16/1997	Kale, L	Anderson, Kenneth W		Lab notebook documenting work performed in anticipation of prior litigation at the request of O. McKinney and containing memos to O. McKinney reflecting and/or requesting legal advice	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1299	2	11/01/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1300	1					Removed and produced	
1301	1	10/16/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1302	2	10/30/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1303	1	10/17/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1304	2	10/02/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1305	2	10/02/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1306	2	10/02/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1307	1	10/02/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1308	1	10/20/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1309	2	10/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1310	4	10/2006	Johnson, Mark S			Testing performed at the request of H. Roper in anticipation of litigation	WP
1311	1	10/2006	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1312	2	06/01/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1313	1	10/29/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1314	2	08/12/2005		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1315	1	03/20/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1316	2	06/01/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1317	1		Johnson, Mark S			Notes regarding references gathered at the request of H. Roper in anticipation of litigation	WP
1318	1	01/21/2005	Johnson, Mark S			Notes regarding patents-in-suit analyzed at the request of H. Roper in anticipation of litigation	WP
1319	1	02/06/2004	Johnson, Mark S	Porter, Greg	Hazlitt, Lonnie; Krupp, Stephen	E-mail correspondence providing information in order to obtain legal advice	AC
1320	6	03/03/1999	Hazlitt, Lonnie	Warrick, Noreen D		Letter sent to counsel in order to obtain legal advice providing information prepared at the request of counsel in anticipation of unrelated litigation	AC, WP
1321	1	04/28/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1322	1	04/28/2006		Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
1323	1		Johnson, Mark S			Folder containing analysis, legal strategy and testing performed at the request of counsel in anticipation of litigation	WP
1324	1		Johnson, Mark S			Notes regarding testing performed at the request of counsel in anticipation of litigation	WP
1325	2	09/18/2004		Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1326	1	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1327	2	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1328	2	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1329	1	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1330	1	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1331	1	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1332	1	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1333	1	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1334	1	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1335	1	01/05/2006	Johnson, Mark S			Handwritten notes regarding analysis performed at the request of H. Roper in anticipation of litigation	WP
1336	1	08/15/2005	Zhou, Zhe	Johnson, Mark S; Redwine, O David	Taha, Angela; Conboy, Claire; Hazlitt, Lonnie; Coker, RW	E-mail correspondence regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1337	6	08/15/2005	Zhou, Zhe	Johnson, Mark S; Redwine, O David	Taha, Angela; Conboy, Claire; Hazlitt, Lonnie; Coker, RW	Attached report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1338	2	08/15/2005	Johnson, Mark S			Notes regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1339	15	01/09/2006		Johnson, Mark S		Testing performed and compiled at the request of H. Roper in anticipation of litigation	WP
1340	1	12/2005	Johnson, Mark S			Notes regarding analysis and testing performed at the request of counsel in anticipation of litigation	WP
1341	3	12/16/2005	Johnson, Mark S.			Notes regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1342	1	12/2005				Folder containing analysis and testing performed at the request of H. Roper in anticipation of litigation	WP
1343	1		Kanuch, Bruce M	Johnson, Mark S		Handwritten note from counsel providing legal advice regarding patent infringement	AC
1344	1					Handwritten notes regarding testing performed at the request of counsel in anticipation of litigation	WP
1345	1					Handwritten notes regarding analysis performed at the request of counsel in anticipation of litigation	WP
1346	1					Handwritten notes regarding analysis performed at the request of counsel in anticipation of litigation	WP
1347	2	09/23/1998	Johnson, Mark S			Slides prepared at the request of counsel in anticipation of prior litigation	WP
1348	1	06/02/1998	Johnson, Mark S			Slide prepared at the request of counsel in anticipation of prior litigation	WP
1349	1	06/02/1998	Johnson, Mark S			Slide prepared at the request of counsel in anticipation of prior litigation	WP
1350	3	06/02/1998	Johnson, Mark S			Slides prepared at the request of counsel in anticipation of prior litigation	WP
1351	1	08/05/1998	Johnson, Mark S			Notes prepared at the request of counsel in anticipation of prior litigation	WP
1352	1	03/26/1998	Lai, Shih-Yaw	Wildi, Markus; Guarino, Carlo Krupp, Stephen; Johnson, Mark S	Ellebracht, Steve; Dupont, Andy; Su, Martin; Ogawa, Katsuhiro; Frencham, Tony; Chum, Stephen; Lai, Shih-Yaw	Correspondence providing information to counsel in order to obtain legal advice and reflecting attorney-client privileged communication	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1353	1	10/17/1997	Johnson, Mark S	Huff, G; Kale, Lawrence Thomas; Parrott, Al	Chum, Stephen; deGroot, A Willem; Ehrhart, S; Ellebracht, S; Hazlitt, Lonnie; Krupp, Stephen; McKinney, Ozborne K; Patel, R; Story, Bruce; Stuart, D	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation	WP
1354	1	10/17/1997	Johnson, Mark S			Correspondence regarding testing performed at the request of counsel in anticipation of prior litigation	WP
1355	2	10/17/1997	Johnson, Mark S	Huff, G; Kale, Lawrence Thomas; Parrott, Al	Chum, Stephen; deGroot, A Willem; Ehrhart, S; Ellebracht, S; Hazlitt, Lonnie; Krupp, Stephen; McKinney, Ozborne K; Patel, R; Story, Bruce; Stuart, D	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation and reflecting attorney-client communications with O. McKinney	AC, WP
1356	2	10/16/1997	Johnson, Mark S			Notes reflecting attorney-client privileged communication with O. McKinney and regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1357	2	09/26/1997	Johnson, Mark S	Huff, G; Kale, Lawrence Thomas; Parrott, Al	Chum, Stephen; deGroot, A Willem; Ehrhart, S; Ellebracht, S; Hazlitt, Lonnie; Krupp, Stephen; McKinney, Ozborne K; Patel, R; Story, Bruce; Stuart, D	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1358	1	09/05/1997	Johnson, Mark S	Huff, G; Parrott, Al; Kale, Lawrence Thomas	Patel, R; Chum, Stephen; McKinney, Ozborne K; Krupp, Stephen; Story, Bruce; Ehrhart, S; Ellebracht, S	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation	WP
1359	1	08/28/1997	Johnson, Mark S	Huff, G; Parrott, Al; Kale, Lawrence Thomas	Patel, R	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation	WP
1360	1	07/02/1997	Lastovica, John; Kale, Larry	Johnson, Mark S; Chum, Pak-Wing S; McKinney, Ozborne K; Markovich, Ronald P; Lastovica, John; Lai, Shih-Yaw		E-mail correspondence reflecting attorney-client privileged communication regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1361	2	06/24/1997		Chum, Stephen; McKinney, Ozborne K; Markovich, Ronald P; Lastovica, John; Lai, S		Correspondence reflecting attorney-client privileged communication regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1362	39	02/10/1997				Testing performed at the request of counsel in anticipation of prior litigation	WP
1363	2	07/02/1997	Johnson, Mark S			Notes containing legal advice of S. Krupp and O. McKinney and reflecting attorney-client privileged communication regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1364	3	08/27/1997	Johnson, Mark S			Notes reflecting attorney-client privileged communication with O. McKinney regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1365	1	08/26/1997	Johnson, Mark S			Notes reflecting attorney-client privileged communication with O. McKinney regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP

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1366	2	07/11/1997	Johnson, Mark S; Kohutek, Jaime; Swogger, Kurt W.; McKinney, Osborne K.	Swogger, Kurt W; Johnson, Mark S; Kalil, Charles; Gambrell, Ed; Korfhage, Glenn; ; Chum, Stephen; Markovich, Ronald P; Lastovica, John; Lai, Shih-Yaw; Kale, Larry	Story, Bruce; Korfhage, Glenn; McKinney, Ozborne K; Carrington, Susan; Swogger, Kurt W.; Krupp, Stephen	E-mail correspondence containing legal advice of O. McKinney regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1367	1	06/27/1997	Kohutek, J; Swogger, Kurt W.; McKinney, Osborne K.	Johnson, Mark S; Kalil, Charles; Gambrell, Ed; Korfhage, Glenn; ; Chum, Stephen; Markovich, Ronald P; Lastovica, John; Lai, Shih-Yaw; Kale, Larry	Carrington, Susan; Swogger, Kurt W.; Korfhage, Glenn; Krupp, Stephen	E-mail correspondence containing legal advice of O. McKinney regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1368	1	12/12/1997	Johnson, Mark S	deGroot, A Willem; Hazlitt, Lonnie; Huff, G; Karjala, Teresa; Krupp, Stephen; Warrick, Noreen N; Dubois, R; Kale, Lawrence Thomas	Chum, Stephen; Docking, D; Story, Bruce; Stuart, D; Montanye, J	E-mail correspondence to counsel regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1369	2	10/27/1997	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Hazlitt, Lonnie; Huff, G; Karjala, Teresa; Krupp, Stephen; Langworthy, J; McKinney, Ozborne K; Parrott, Al; Stevens, James; Warrick, Noreen N; Dubois, R; Kale, Lawrence Thomas	Docking, D; Story, Bruce; Stuart, D; Montanye, J	E-mail correspondence to counsel regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1370	2	10/27/1997	Johnson, Mark S			Notes reflecting attorney-client privileged communication with S. Krupp, O. McKinney, and N. Warrick regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP

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1371	1	10/20/1997	Langworthy, J	Johnson, Mark S	Docking, D; Krupp, Stephen; McKinney, Ozborne K; Warrick, Noreen N; Story, Bruce; Hazlitt, Lonnie; Stevens, James; Chum, Stephen; deGroot, A Willem; Huff, G; Karjala, Teresa; Parrott, Al; Stuart, D	E-mail correspondence reflecting attorney-client privileged communication regarding work performed at the request of counsel in anticipation of prior litigation	WP
1372	1	10/20/1997	Story, Bruce; Johnson, Mark S	Johnson, Mark S; Chum, Stephen; Degroot, Willem; Hazlitt, Lonnie; Huff, Georgia; Karjala, Teresa; Krupp, Stephen; Langworthy, John; McKinney, Osborne K.; Parrott, Albert; Stevens, James; Warrick, Noreen D	Docking, Darrel; Story, Bruce; Stuart, Duncan	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation and reflecting attorney-client communications with S. Krupp, O. McKinney, and N. Warrick	AC, WP
1373	1	10/20/1997	McKinney, Ozborne K	Johnson, Mark S; Hazlitt, Lonnie	Docking, D; Story, Bruce; Stuart, D; Krupp, Stephen; Langworthy, J; Parrott, Al; Warrick, Noreen N	E-mail correspondence reflecting attorney-client privileged communication regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1374	2	10/29/1997	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Huff, G; Karjala, Teresa; Krupp, Stephen; Langworthy, J; McKinney, Ozborne K; Parrott, Al; Stevens, James; Warwick, N; Dubois, R; Kale, Lawrence Thomas; Hazlitt, Lonnie	Docking, D; Story, Bruce; Stuart, D; Montanye, J	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1375	2	10/27/1997	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Hazlitt, Lonnie; Huff, G; Karjala, Teresa; Krupp, Stephen; Langworthy, J; McKinney, Ozborne K; Parrott, Al; Stevens, James; Warwick, N; Dubois, R; Kale, Lawrence Thomas	Docking, D; Story, Bruce; Stuart, D; Montanye, J	E-mail correspondence reflecting attorney-client privileged communication regarding work performed at the request of counsel in anticipation of prior litigation	WP
1376	1	01/08/1998	Johnson, Mark S			Notes prepared at the request of counsel in anticipation of prior litigation	WP
1377	1	10/23/1997	Johnson, Mark S			Notes prepared at the request of counsel in anticipation of prior litigation	WP
1378	1	10/23/1997	Johnson, Mark S			Slide prepared at the request of counsel in anticipation of prior litigation	WP
1379	4	04/29/1997				Patent application summary prepared at the request of counsel in anticipation of prior litigation	WP
1380	3	06/24/1997				Patent application summary prepared at the request of counsel in anticipation of prior litigation	WP
1381	1	6/1997	Johnson, Mark S			Handwritten notes reflecting attorney-client privileged communications with O. McKinney regarding patent strategy	AC
1382	1	06/24/1997	McKinney, Ozborne K	Chum, Stephen; Markovich, Ronald P; Lai, S; Fordyce, William; Story, Bruce; Docking, Darrel; Swogger, Kurt W; Johnson, Mark S; Castello, Rick; Torres, T; Springs, B; Krupp, Stephen; Koch, Kaeyln; Carrington, S; Pierce, J	Chum, Pak-Wing S; Markovich, Ronald P; Knight, George W; Lai, S	Correspondence providing legal advice regarding patent application	AC

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1383	1	06/24/1997	McKinney, Ozborne K	Chum, Stephen; Markovich, Ronald P; Lai, S; Fordyce, William; Story, Bruce; Docking, Darrel; Swogger, Kurt W; Johnson, Mark S; Castello, Rick; Torres, T; Springs, B; Krupp, Stephen; Koch, Kaeyln; Carrington, S; Pierce, J	Chum, Pak-Wing S; Markovich, Ronald P; Knight, George W; Lai, S	Correspondence providing legal advice regarding patent application	AC
1384	3	06/24/1997				Patent application summary prepared at the request of counsel in anticipation of prior litigation	WP
1385	1	06/24/1997	McKinney, Ozborne K	Chum, Stephen; Markovich, Ronald P; Lai, S; Fordyce, William; Story, Bruce; Docking, Darrel; Swogger, Kurt W; Johnson, Mark S; Castello, Rick; Torres, T; Springs, B; Krupp, Stephen; Koch, Kaeyln; Carrington, S; Pierce, J	Chum, Pak-Wing S; Markovich, Ronald P; Knight, George W; Lai, S	Correspondence providing legal advice regarding patent application	AC
1386	1	10/23/1997	Johnson, Mark S			Notes prepared at the request of counsel in anticipation of prior litigation	WP
1387	1	10/23/1997	Johnson, Mark S			Slides prepared at the request of counsel in anticipation of prior litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1388	1	10/06/1997	Johnson, Mark S; McKinney, Ozborne K	McKinney, Ozborne K; Gambrell, Ed; Swogger, Kurt W.; Kalil, Charles	Chum, Stephen; Lai, Shih-Yaw; Carrington, Susan; Degroot, Jackie; Vanderhider, Alan; Story, Bruce; Docking, Darrel; Johnson, Mark S; Huff, Georgia; Stuart, DuncanK; Korfhage, Glenn; Krupp, Stephen; Warrick, Noreen D	E-mail correspondence reflecting attorney-client privileged communications between M. Johnson and O. McKinney	AC
1389	1	08/20/1997	Story, Bruce	Gambrell, E; Swogger, Kurt W; Kalil, Charles	Chum, Stephen; Docking, Darrel; Johnson, Mark S; Korfhage, Glenn; Krupp, Stephen; McKinney, Ozborne K; Carrington, S	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation	WP
1390	2	10/07/1997	Johnson, Mark S			Slides prepared at the request of counsel in anticipation of prior litigation	WP
1391	2	10/1997	Johnson, Mark S			Notes prepared at the request of counsel in anticipation of prior litigation	WP
1392	1	07/02/1997	Lastovica, John; Kale, Larry	Johnson, Mark S; Chum, Stephen; McKinney, Ozborne K; Markovich, Ronald P; Lastovica, John; Lai, Shih-Yaw		E-mail correspondence reflecting attorney-client communication regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1393	2	06/24/1997	Kale, Larry	Chum, Stephen; McKinney, Ozborne K; Markovich, Ronald P; Lastovica, John; Lai, S		Correspondence reflecting attorney-client communications regarding work performed at the request of counsel in anticipation of prior litigation	AC, WP
1394	39	02/10/1997				Testing performed at the request of counsel in anticipation of prior litigation	WP
1395	48	12/21/2004	Reichek, Ken			Lab notebook documenting testing performed at the request of H. Roper in anticipation of litigation	WP

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1396	3					Removed and produced	
1397	1					Removed and produced	
1398	5					Removed and produced	
1399	1			Markovich, Ronald P		Claim of patent application and analysis reflecting attorney-client communications between S. Krupp and/or O. McKinney and Ron Markovich	AC
1400	50	12/21/2004	Reichek, Ken			Lab notebook documenting testing performed at the request of H. Roper in anticipation of litigation	WP
1401	50	08/28/2003	Reichek, Ken			Lab notebook documenting testing performed at the request of G. Porter in anticipation of litigation	WP
1402	74	03/09/2005	Reichek, Ken			Lab notebook documenting testing performed at the request of H. Roper in anticipation of litigation	WP
1403	345	05/01/2007	Parrot, Albert			Testing performed at the request of H. Roper in anticipation of litigation	WP
1404	249	06/06/2007	Parrot, Albert			Testing performed at the request of H. Roper in anticipation of litigation	WP
1405	213	01/15/2007	Parrot, Albert			Testing performed at the request of H. Roper in anticipation of litigation	WP
1406	5	10/09/2006	Parrot, Albert			Testing performed at the request of H. Roper in anticipation of litigation	WP
1407	6	10/30/2006	Parrot, Albert			Testing performed at the request of H. Roper in anticipation of litigation	WP
1408	47	10/19/2006	Parrot, Albert			Testing performed at the request of H. Roper in anticipation of litigation	WP
1409	98	10/11/2006	Parrot, Albert			Testing performed at the request of H. Roper in anticipation of litigation	WP
1410	89					Testing performed at the request of counsel in anticipation of litigation	WP
1411	122	11/04/2004	Johnson, Mark S			Report regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1412	208	06/10/1996	McKinney, Ozborne K			Chart indexing abstracts of patent portfolio and reflecting attorney-client communications between O. McKinney and K. Swogger, S. Chum, and B. Story regarding patent coverage	AC
1413	32	06/10/1996	McKinney, Ozborne K			Chart indexing abstracts of patent portfolio and reflecting attorney-client communications between O. McKinney and K. Swogger, S. Chum, and B. Story regarding patent coverage	AC
1414	2	04/25/1994	Warrick, Noreen D			Chart regarding patent portfolio provided to O. McKinney and reflecting attorney-client communication between N. Warrick, Esq. and K. Swogger, S. Chum, and B. Story	AC
1415	2	03/03/1995				Draft chart regarding legal advice requested on competitive patents and reflecting attorney-client communications between O. McKinney and S. Chum and K. Koch	AC
1416	1	06/19/1996	deGroot, Jacquelyn A	Krupp, Stephen; McKinney, Ozborne K; Warrick, Noreen D;		Facsimile attaching agenda and meeting notes reflecting attorney-client communications with Legal Department	AC
1417	1	06/19/1996	deGroot, Jacquelyn A	Krupp, Stephen; McKinney, Ozborne K; Warrick, Noreen D; Koch, Kaeyln; Docking, Darrel; Hazlitt, Lonnie		Facsimile summary of earlier meeting regarding patent strategies and reflecting attorney-client privileged communications with Legal Department	AC
1418	3	06/11/1996	Hazlitt, Lonnie	Degroot, Jackie; Krupp, Stephen; McKinney, Ozborne K; Warrick, Noreen D; Koch, Kaeyln; Docking, Darrel; Hazlitt, Lonnie		Facsimile chart with handwritten notes from meeting regarding patent strategies and reflecting attorney-client privileged communications with Legal Department	AC

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1419	1	06/19/1996		Krupp, Stephen; McKinney, Ozborne K; Warrick, Noreen D; ; Koch, Kaeyln; Docking, Darrel; Hazlitt, Lonnie		Facsimile notes from meeting reflecting attorney-client privileged communications with Legal Department	AC
1420	9	06/08/1996	deGroot, Jacquelyn A	Krupp, Stephen; McKinney, Ozborne K; Warrick, Noreen D; ; Koch, Kaeyln; Docking, Darrel; Hazlitt, Lonnie		Facsimile attachment regarding technology, provided to counsel for purpose of obtaining legal advice	AC
1421	1	04/2005	Kanuch, Bruce M			Handwritten note prepared by Dow attorney in anticipation of litigation	WP
1422	1	04/14/2005	Kanuch, Bruce M	Ward, Susan M.		Handwritten note regarding providing information to H. Roper and prepared in anticipation of litigation	WP
1423	1	04/14/2005	Ward, Susan M.; Kanuch, Bruce M	Roper, Harry J		Facsimile sent at request of Dow attorney to H. Roper in anticipation of litigation	WP
1424	1	04/14/2005	Ward, Susan M; Kanuch, Bruce M	Roper, Harry J		Facsimile sent at request of Dow attorney attaching information prepared at the request of H. Roper in anticipation of litigation	WP
1425	2	10/29/1997	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Huff, Georgia; Karjala, Teresa; Krupp, Stephen; Langworthy, John; McKinney, Ozborne K; Parrott, Albert; Stevens, James; Warrick, Noreen N; Dubois, Robert; Kale, Larry; Hazlitt, Lonnie	Docking, Darrel; Story, Bruce; Stuart, Duncan; Montanye, Jeff	E-mail exchange reflecting attorney-client privileged communication with Legal Department and containing a summary of information prepared at the request of counsel in anticipation of prior litigation	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1426	2	10/27/1997	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Hazlitt, Lonnie; Huff, Georgia; Karjala, Teresa; Krupp, Stephen; Langworthy, John; McKinney, Ozborne K; Parrott, Albert; Stevens, James; Warrick, Noreen N; Dubois, Robert; Kale, Larry	Docking, Darrel; Story, Bruce; Duncan, Stuart; Montanye, Jeff	E-mail exchange reflecting attorney-client privileged communication with Legal Department and containing a summary of information prepared at the request of counsel in anticipation of prior litigation	AC, WP
1427	2	11/04/1997	Stuart, Duncan	McKinney, Ozborne K		E-mail correspondence providing information in response to legal advice and reflecting attorney-client privileged communications with O. McKinney	AC
1428	3	06/24/1997	Kale, Larry	McKinney, Ozborne K	Chum, Pak-Wing S; Markovich, Ronald P; Lai, Shih-Yaw; Lastovica, John	Fax providing information requested by counsel in order to provide legal advice	AC
1429	8	06/08/1996	McKinney, Ozborne K			Analysis of '497 application reflecting attorney-client privileged communications with O. McKinney and K. Swogger, J. Degroot, and K. Koch	AC
1430	1	06/19/1996	Hazlitt, Lonnie	McKinney, Ozborne K; Krupp, Stephen; Warrick, Noreen D		E-mail regarding patent strategy reflecting attorney-client privileged communications with O. McKinney and Legal Department	AC
1431	1	06/19/1996	Hazlitt, Lonnie; Oswald, Tom; Lai, Shih-Yaw	McKinney, Ozborne K; Krupp, Stephen; Warrick, Noreen D		E-mail attachment providing technical information to counsel in order to obtain legal advice	AC
1432	1	06/19/1996	deGroot, Jacquelyn A	McKinney, Ozborne K; Warrick, Noreen D; Krupp, Stephen		Facsimile attaching agenda and meeting notes reflecting attorney-client privileged communications with Legal Department	AC
1433	1	06/19/1996	deGroot, Jacquelyn A	McKinney, Ozborne K; Warrick, Noreen D; Krupp, Stephen; Docking, Darrel; Koch, Kaeyln; Hazlitt, Lonnie		Facsimile summary with attorney handwritten notes regarding earlier meeting on patent strategies and reflecting attorney-client privileged communications with Legal Department	AC

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1434	4	06/11/1996	Hazlitt, Lonnie	Degroot, Jackie; Krupp, Stephen; McKinney, Ozborne K; Warrick, Noreen D; ; Koch, Kaeyln; Docking, Darrel; Hazlitt, Lonnie		Facsimile chart with handwritten notes from meeting regarding patent strategies and reflecting attorney-client privileged communications with Legal Department	AC
1435	9	06/09/1996	deGroot, Jacquelyn A	Krupp, Stephen; McKinney, Ozborne K; Warrick, Noreen D; ; Koch, Kaeyln; Docking, Darrel; Hazlitt, Lonnie		Facsimile attachment regarding technology and provided to counsel for purpose of obtaining legal advice	AC
1436	1	06/23/1997	deGroot, Jacquelyn A	McKinney, Ozborne K; Hazlitt, Lonnie; Jain, Pradeep	Smith, Dave; Schwank, Don; Koch, Kaeyln; Lastovica, John; Cobler, Brad; Ramsey, David; Niemann, Debra; Patel, Rajen; Allgeuer, Thomas; Fehr, Bernard	E-mail providing information and supporting attachment to patent counsel in order to obtain legal advice	AC
1437	2	06/23/1997	deGroot, Jacquelyn A	McKinney, Ozborne K; Hazlitt, Lonnie; Jain, Pradeep	Smith, Dave; Schwank, Don; Koch, Kaeyln; Lastovica, John; Cobler, Brad; Ramsey, David; Niemann, Debra; Patel, Rajen; Allgeuer, Thomas; Fehr, Bernard	Report provided to patent counsel in order to obtain legal advice	AC
1438	3	04/01/1996	Docking, Darrel; Krupp, Stephen	McKinney, Osborne K.		Chart with attorney handwritten notes regarding patent relationships and providing information to counsel in order to obtain legal advice	AC
1439	1					Removed and produced	

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1440	1					Redaction: Agenda item reflecting attorney-client privileged communication with O. McKinney (Removed and produced)	AC
1441	21					Redaction: Information reflecting attorney-client communications with Dow legal department regarding patent positions (Removed and produced)	AC
1442	9					Removed and produced	
1443	4					Removed and produced	
1444	1					Removed and produced	
1445	5	02/00/1996	McKinney, Ozborne K			Report prepared by counsel providing legal advice to K. Swogger	AC
1446	1	02/00/1996	Docking, Darrel	McKinney, Osborne K.		Report reflecting attorney-client communications between D. Docking and S. Krupp, O. McKinney, and N. Warrick regarding importance of patent applications	AC
1447	1					Removed and produced	
1448	16					Removed and produced	
1449	2	04/01/1996	McKinney, Osborne K.			Chart with attorney handwritten notes regarding patent relationships and reflecting attorney-client privileged communications between O. McKinney and K. Swogger, S. Chum, and B. Story regarding patent coverage	AC
1450	4	07/15/1997	McKinney, Ozborne K			Chart with attorney handwritten notes regarding patent relationships and reflecting attorney-client privileged communications between O. McKinney and K. Swogger, S. Chum, and B. Story regarding patent coverage	AC
1451	1	04/01/1996	McKinney, Osborne K.			Chart with attorney handwritten notes regarding patent relationships and reflecting attorney-client privileged communications between O. McKinney and K. Swogger, S. Chum, and B. Story regarding patent coverage	AC

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1452	122	11/04/2004	Johnson, Mark S			Report regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1453	1	04/05/2005	Johnson, Mark S	Fordyce, William; Glenn, Michael L; Korfhage, Glenn; Story, Bruce	Kanuch, Bruce; Krupp, Stephen; Turk, Thelma	E-mail correspondence providing attorney work product prepared in anticipation of litigation to M. Glenn, B. Kanuch, and S. Krupp in order to obtain legal advice	AC, WP
1454	26	04/08/2005	Johnson, Mark S; Kanuch, Bruce M	Schwartz, Roger; Fordyce, William; Glenn, Michael L; Korfhage, Glenn; Story, Bruce	Kanuch, Bruce; Krupp, Stephen; Turk, Thelma	Attached report regarding analysis and testing performed at the request of H. Roper in anticipation of litigation and providing legal advice to Dow management	AC, WP
1455	2	04/05/2005	Kanuch, Bruce M; Johnson, Mark S	Fordyce, William; Glenn, Michael L; Johnson, Mark S; Korfhage, Glenn; Story, Bruce	Krupp, Stephen; Turk, Thelma; Kanuch, Bruce M	E-mail correspondence providing attorney work product prepared in anticipation of litigation to M. Glenn, B. Kanuch, and S. Krupp in order to obtain legal advice	AC, WP
1456	22	04/14/2005	Kanuch, Bruce M	Fordyce, William; Glenn, Michael L; Johnson, Mark S; Korfhage, Glenn; Story, Bruce	Krupp, Stephen; Turk, Thelma; Kanuch, Bruce M	Attached attorney work product presentation regarding analysis and testing performed in anticipation of litigation and providing legal advice to Dow management	AC, WP
1457	2	05/29/2003	Johnson, Mark S; Story, Bruce; Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn; Kreinberg, Romeo; Bell, Robert; Hasenbeck, Ken; Swogger, Kurt W.; Schwartz, Roger; Glenn, Michael L; Story, Bruce	Bellmore, David; Cobler, Brad; Dowling, Nicole; Kardos, Lori; Koch, Kaelyn; Krupp, Stephen; Peters, Herbert; Presa, John; Ramsey, David; Smith, Dave; Wooster, Jeffrey	Redaction: E-mail correspondence reflecting attorney-client communications with S. Krupp regarding patent infringement (Removed and produced)	AC
1458	24	08/20/2003	Vanderhider, Alan			Presentation regarding analysis performed at the request of M. Glenn in anticipation of litigation	WP
1459	4					Removed and produced	

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1460	42	04/15/2004	Johnson, Mark S			Presentation prepared at the request of G. Porter in anticipation of litigation	WP
1461	2	08/11/2003				Redaction: Agenda regarding meeting reflecting request for legal advice from S. Krupp regarding patent strategy (Removed and produced)	AC
1462	44	01/19/2004	Krupp, Stephen; Johnson, Mark S	Jenkens & Gilchrist		Attorney work product presentation regarding analysis and testing performed in anticipation of litigation and providing legal advice of S. Krupp	WP, AC
1463	17	01/19/2004	Johnson, Mark S; Krupp, Stephen	Jenkens & Gilchrist		Attorney work product presentation regarding analysis and testing performed in anticipation of litigation and providing legal advice of S. Krupp	WP, AC
1464	34	01/19/2004	Johnson, Mark S; Krupp, Stephen	Jenkens & Gilchrist		Attorney work product presentation regarding analysis and testing performed in anticipation of litigation and providing legal advice of S. Krupp	WP, AC
1465	64	01/19/2004	Johnson, Mark S; Krupp, Stephen	Jenkens & Gilchrist		Attorney work product presentation regarding analysis and testing performed in anticipation of litigation and providing legal advice of S. Krupp	WP, AC
1466	163	01/19/2004	Johnson, Mark S; Krupp, Stephen	Jenkens & Gilchrist		Attorney work product presentation regarding analysis and testing performed in anticipation of litigation and providing legal advice of S. Krupp	WP, AC
1467	103	01/19/2004	Johnson, Mark S	Porter, Greg		Draft technology presentation prepared at the request of G. Porter in anticipation of litigation and presented in order to obtain legal advice	AC, WP
1468	15	01/15/2004	Hazlitt, Lonnie			Report regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
1469	2	01/19/2004	Johnson, Mark S			Agenda for meeting with G. Porter in order to obtain legal advice in anticipation of litigation	WP

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1470	24	10/23/2003	Johnson, Mark S			Presentation regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
1471	6	02/13/2004	Johnson, Mark S; Reichek, Ken; Hazlitt, Lonnie; Wakefield, Charles			Attorney work product draft presentation regarding analysis and testing performed at the request of G. Porter in anticipation of litigation reflecting attorney-client communications with C. Wakefield	WP, AC
1472	22	09/09/2003	Johnson, Mark S			Attorney work product presentation regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
1473	22	12/19/2003	Johnson, Mark S			Attorney work product presentation regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
1474	4	10/06/2003	Johnson, Mark S.			Slides prepared at the request of M. Glenn in anticipation of litigation	WP
1475	31	09/09/2003	Johnson, Mark S			Presentation prepared at the request of M. Glenn in anticipation of litigation	WP
1476	8	10/04/2003	Krupp, Stephen			Attorney work product draft presentation regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation reflecting attorney-client communications with S. Krupp	AC, WP
1477	24	10/23/2003	Johnson, Mark S			Attorney work product presentation regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
1478	24	06/10/2004	Johnson, Mark S			Attorney work product presentation regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP

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1479	36	06/10/2004	Johnson, Mark S			Attorney work product presentation regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
1480	16	10/27/2004	Reicheck, Ken	Johnson, Mark S.		Testing performed at the request of G. Porter in anticipation of litigation	WP
1481	1	09/11/2003	Hazlitt, Lonnie; Williams, Allen	Williams, Allen; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken	Johnson, Mark S; Reichek, Ken	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
1482	1	09/10/2003	Williams, Allen	Johnson, Mark S.; Reichek, Ken		Notes on testing performed at the request of M. Glenn in anticipation of litigation	WP
1483	11	10/10/2003	Reichek, Ken; Hagen, Charles			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1484	1	09/10/2003	Williams, Allen	Johnson, Mark S.; Reichek, Ken		Notes on testing performed at the request of M. Glenn in anticipation of litigation	WP
1485	7	10/09/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1486	1	09/10/2003	Williams, Allen	Johnson, Mark S.; Reichek, Ken		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1487	4	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1488	7	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1489	2	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1490	11	10/11/2003	Hagen Jr, Charles	Reichek, Ken		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1491	1	09/16/2003	Williams, Allen	Johnson, Mark S.; Reichek, Ken		Notes on testing performed at the request of M. Glenn in anticipation of litigation	WP
1492	7	10/09/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1493	1	09/16/2003	Williams, Allen	Johnson, Mark S.; Reichek, Ken		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1494	3	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP

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1495	7	10/09/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1496	1	10/10/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1497	2	10/10/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1498	11	10/20/2003	Reichek, Ken; Hagen, Charles			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1499	1	09/23/2003	Williams, Allen			Notes on testing performed at the request of M. Glenn in anticipation of litigation	WP
1500	1	09/23/2003		Reichek, Ken; Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1501	3	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1502	7	11/04/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1503	2	11/05/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1504	5	01/07/2004	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1505	36	02/17/2004	Gillespie, David			Testing performed at the request of G. Porter in anticipation of litigation	WP
1506	65	11/14/2003	Reichek, Ken; Hagen, Charles			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1507	60	11/20/2003	Nelson, Mike	Reichek, Ken		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1508	1	11/20/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1509	1	11/24/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1510	7	11/19/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1511	1	11/19/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1512	7	11/24/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP

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1513	7	11/15/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1514	7	12/04/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1515	65	02/19/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1516	48	02/18/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1517	1	02/20/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1518	2	02/19/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1519	4	11/01/2003	Reichek, Ken; Johnson, Mark S.			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1520	1	10/30/2003	Hazlitt, Lonnie	Johnson, Mark S	Reichek, Ken; Williams, Allen	E-mail correspondence attaching report regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
1521	20	10/30/2003	Hazlitt, Lonnie	Johnson, Mark S	Reichek, Ken; Williams, Allen	Testing performed at the request of M. Glenn in anticipation of litigation	WP
1522	3	11/03/2003	Hazlitt, Lonnie	Johnson, Mark S; Reichek, Ken		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
1523	7	10/29/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1524	1	11/03/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1525	36	11/06/2003	Johnson, Mark S.			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1526	4	06/04/2004	Johnson, Mark S.			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1527	1	11/10/2003	Hagen Jr, Charles	Reichek, Ken		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1528	5	11/26/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1529	7	11/10/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP

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1530	4	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1531	9	10/27/2003	Williams, Allen	Johnson, Mark S.		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1532	7	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1533	7	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1534	7	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1535	7	10/21/2003	Williams, Allen			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1536	4	04/03/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1537	15	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
1538	32	06/01/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1539	63	03/22/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1540	63	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1541	63	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1542	63	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1543	63	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1544	63	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP

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1545	63	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1546	63	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1547	65	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1548	65	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1549	65	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1550	65	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1551	65	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1552	65	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		Testing performed at the request of G. Porter in anticipation of litigation	WP
1553	1	03/23/2004	Hagen Jr, Charles	Johnson, Mark S; Reichek, Ken; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1554	1	03/25/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1555	7	03/25/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1556	7	04/07/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1557	7	03/18/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1558	2	06/01/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP

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1559	2	06/17/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1560	7	03/17/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1561	2	03/19/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1562	7	03/19/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1563	2	03/22/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1564	7	03/25/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1565	2	03/25/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1566	2	08/23/2004	Johnson, Mark S	Reichek, Ken		Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1567	33	06/01/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1568	6	05/24/2004	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1569	4	09/27/2004	Johnson, Mark S			Notes regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1570	43	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
1571	12	06/01/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1572	15	06/01/2004	Johnson, Mark S.; Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
1573	15	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
1574	145	08/29/2005	Johnson, Mark S.			Testing performed at the request of H. Roper in anticipation of litigation	WP
1575	6	08/15/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
1576	145	02/01/2005	Reichek, Ken			Testing performed at the request of counsel in anticipation of litigation	WP

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1577	5	09/22/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1578	3	10/20/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1579	51	10/24/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1580	37	06/01/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1581	62	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1582	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1583	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1584	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1585	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1586	64	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1587	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1588	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1589	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1590	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1591	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1592	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1593	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1594	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1595	33	06/01/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP

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1596	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1597	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1598	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1599	63	05/24/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1600	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1601	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1602	63	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1603	65	05/23/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1604	65	05/24/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1605	65	05/24/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1606	65	05/24/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1607	63	05/24/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1608	65	05/24/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1609	65	05/24/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1610	33	06/01/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1611	63	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1612	63	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1613	63	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1614	63	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP

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1615	63	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1616	63	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1617	63	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1618	65	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1619	65	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1620	65	05/29/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1621	65	05/30/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1622	65	05/30/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1623	65	05/30/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1624	65	05/30/2004	Reichek, Ken; Hagen, Charles			Testing performed at the request of G. Porter in anticipation of litigation	WP
1625	1	05/26/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1626	1	05/26/2004	Johnson, Mark S.; Coker, Wayne			Testing performed at the request of G. Porter in anticipation of litigation	WP
1627	1	05/26/2004	Johnson, Mark S.; Coker, Wayne			Testing performed at the request of G. Porter in anticipation of litigation	WP
1628	22	07/13/2004	Johnson, Mark S.; Coker, Wayne			Testing performed at the request of G. Porter in anticipation of litigation	WP
1629	20	07/13/2004	Johnson, Mark S.; Coker, Wayne			Testing performed at the request of G. Porter in anticipation of litigation	WP
1630	1	10/14/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1631	1	10/14/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1632	1	10/15/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1633	156	10/14/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1634	57	01/12/2006	Johnson, Mark S.			Testing collected and performed at the request of H. Roper in anticipation of litigation	WP
1635	1	10/19/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1636	7	05/20/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
1637	7	05/20/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
1638	1	10/03/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1639	1	10/03/2003	Nelson, Mike			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1640	2	05/17/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1641	3	05/17/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1642	7	05/14/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1643	1	05/14/2004 - 05/17/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1644	2	05/17/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1645	7	05/15/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1646	1	05/15/2004 - 05/17/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1647	2	05/27/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1648	2	05/27/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1649	7	05/27/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1650	1	05/27/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1651	2	05/27/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1652	50	03/15/2005	Johnson, Mark S.			Testing performed at the request of H. Roper in anticipation of litigation	WP
1653	7	12/01/2004 - 12/03/2004	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1654	1	12/01/2004 - 12/06/2004	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1655	2	12/06/2004	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1656	1	04/30/2005	Johnson, Mark S.; Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1657	1	04/30/2005	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1658	3	03/15/2005	Johnson, Mark			Testing performed at the request of H. Roper in anticipation of litigation	WP
1659	1	03/14/2005	Gillespie, David			Testing performed at the request of H. Roper in anticipation of litigation	WP
1660	4	11/18/2004				Testing performed at the request of G. Porter in anticipation of litigation	WP
1661	13					Removed and produced	
1662	255	05/16/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1663	5	01/17/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1664	90	01/21/2005	Reichek, Ken; Hagen, Charles			Testing performed at the request of H. Roper in anticipation of litigation	WP
1665	49	01/19/2005	Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1666	1	05/24/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding and attaching testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1667	5	05/24/2005	Zhou, Zhe; Green, Shayne; Conboy, Claire	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Attached testing performed at the request of H. Roper in anticipation of litigation	WP
1668	1	03/29/2005	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1669	3	05/10/2005	Zhou, Zhe			Testing performed at the request of H. Roper in anticipation of litigation	WP
1670	5	05/18/2005	Zhou, Zhe; Green, Shayne; Conboy, Claire			Testing performed at the request of H. Roper in anticipation of litigation	WP
1671	5	05/24/2005	Zhou, Zhe; Green, Shayne; Conboy, Claire			Testing performed at the request of H. Roper in anticipation of litigation	WP
1672	8	05/26/2005	Zhou, Zhe			Testing performed at the request of H. Roper in anticipation of litigation	WP
1673	4	06/03/2005	Zhou, Zhe			Testing performed at the request of H. Roper in anticipation of litigation	WP
1674	6	06/08/2005	Zhou, Zhe			Testing performed at the request of H. Roper in anticipation of litigation	WP
1675	1	01/28/2005	Zhou, Zhe	Conboy, Claire; Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1676	4	01/28/2005	Zhou, Zhe; Conboy, Claire	Conboy, Claire; Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Reichek, Ken	Testing performed at the request of H. Roper in anticipation of litigation	WP
1677	3	05/17/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1678	2	08/20/2004		Johnson, Mark S; Reichek, Ken		Testing performed at the request of G. Porter in anticipation of litigation	WP
1679	1	10/08/2004		Johnson, Mark S; Reichek, Ken		Testing performed at the request of G. Porter in anticipation of litigation	WP
1680	2					Removed otherwise privileged document as not relevant to this litigation	
1681	1	02/04/2005	Zhou, Zhe	Conboy, Claire; Johnson, Mark S; Taha, Angela		E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1682	2	02/04/2005	Zhou, Zhe			Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1683	3	10/26/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1684	6	07/02/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1685	10	08/12/2005	Johnson, Mark S.; Coker, Wayne			Testing performed at the request of H. Roper in anticipation of litigation	WP
1686	18	10/26/2004	Johnson, Mark S.; Coker, Wayne			Testing performed at the request of G. Porter in anticipation of litigation	WP
1687	1	08/27/2004	Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Johnson, Mark S	Taha, Angela	E-mail correspondence regarding attached privileged testing performed at the request of G. Porter in anticipation of litigation	WP
1688	6	08/27/2005	Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Johnson, Mark S	Taha, Angela	Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1689	7	04/01/2005	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1690	1	04/05/2005	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1691	1	04/05/2005	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1692	1	06/23/2005	Nelson, Mike	Johnson, Mark S; Reichek, Ken	Gillespie, David	E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1693	1	06/23/2005	Nelson, Mike			Attached presentation slides regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1694	1	06/23/2005	Nelson, Mike			Attached presentation slides regarding privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1695	7	06/23/2005	Nelson, Mike			Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1696	1	06/15/2005	Johnson, Mark S; Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe; Johnson, Mark S		E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1697	1	06/15/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe; Johnson, Mark S		Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1698	7	06/10/2005				Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1699	7	03/11/2005 - 03/12/2005	Nelson, Mike			Testing performed at the request of H. Roper in anticipation of litigation	WP
1700	1	03/11/2005 - 03/31/2005	Nelson, Mike			Presentation slides regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1701	2	03/31/2005	Nelson, Mike			Presentation slides regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1702	1	02/28/2005	Conboy, Claire	Coker, Wayne; Crown, Alechia; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela; Turk, Thelma; Zhou, Zhe		E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1703	1	02/28/2005	Conboy, Claire	Coker, Wayne; Crown, Alechia; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Reichek, Ken; Taha, Angela; Turk, Thelma; Zhou, Zhe		Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1704	18	10/17/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1705	3	02/04/2005	Taha, Angela; Zhou, Zhe; Conboy, Claire	Conboy, Claire; Johnson, Mark S; Zhou, Zhe; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1706	8	10/15/2004	Johnson, Mark S.; Taha, Angela			Testing performed at the request of G. Porter in anticipation of litigation	WP
1707	1	05/31/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1708	7	05/31/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1709	7	10/26/2004	Taha, Angela			Testing performed at the request of G. Porter in anticipation of litigation	WP
1710	6	10/13/2004	Johnson, Mark S.; Taha, Angela			Testing performed at the request of G. Porter in anticipation of litigation	WP
1711	6	10/20/2004	Taha, Angela			Testing performed at the request of G. Porter in anticipation of litigation	WP
1712	6	10/19/2004	Taha, Angela			Testing performed at the request of G. Porter in anticipation of litigation	WP
1713	1	06/02/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1714	8	06/02/2005	Zhou, Zhe			Attached slides regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1715	9	02/07/2005	Zhou, Zhe			Testing performed at the request of H. Roper in anticipation of litigation	WP
1716	4	03/02/2005	Hazlitt, Lonnie; Conboy, Claire; Johnson, Mark S	Conboy, Claire; Johnson, Mark S; Hazlitt, Andrea; Turk, Thelma; Taha, Angela; Reichek, Ken;; Coker, Wayne; Green, Shayne; Crown, Alechia; Zhou, Zhe		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1717	2	08/18/2004	Taha, Angela; Johnson, Mark S	Johnson, Mark S; Redwine, David; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1718	2	02/04/2005	Taha, Angela; Zhou, Zhe; Conboy, Claire	Conboy, Claire; Johnson, Mark S; Zhou, Zhe; Taha, Angela		E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1719	6	02/04/2005	Taha, Angela	Conboy, Claire; Johnson, Mark S; Zhou, Zhe; Taha, Angela		Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1720	2	01/31/2005	Zhou, Zhe; Johnson, Mark S	Conboy, Claire; Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1721	5	10/19/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1722	7	10/19/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1723	11	11/15/2004	Balke, Stephen			Testing performed at the request of G. Porter in anticipation of litigation	WP
1724	5	01/26/2005	Johnson, Mark			Minutes from meeting regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1725	1	02/09/2005	deGroot, Jacquelyn A; Zhou, Zhe			Testing performed at the request of H. Roper in anticipation of litigation	WP
1726	1	08/31/2004	Yusuf, Siaka	Johnson, Mark S; Reichek, Ken		Testing performed at the request of G. Porter in anticipation of litigation	WP
1727	2	10/19/2004	Burns, Don	Reichek, Ken; Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
1728	5	03/2004 - 04/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1729	5	04/22/2004	Reichek, Ken	Johnson, Mark S.		Testing performed at the request of G. Porter in anticipation of litigation	WP
1730	5	04/26/2004	Reichek, Ken	Johnson, Mark S.		Testing performed at the request of G. Porter in anticipation of litigation	WP
1731	5	05/11/2004	Reichek, Ken	Johnson, Mark S.		Testing performed at the request of G. Porter in anticipation of litigation	WP

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1732	1	09/28/2005	Nelson, Mike	Johnson, Mark S	Gillespie, David	E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1733	4	09/28/2005	Nelson, Mike			Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1734	4	09/14/2005	Johnson, Mark S.			Testing performed at the request of H. Roper in anticipation of litigation	WP
1735	201	05/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1736	196	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1737	206	05/15/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1738	208	05/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1739	7	04/26/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1740	5	09/22/2004	Reichek,Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1741	1	09/24/2004	Johnson, Mark S.			Presentation slide regarding testing performed at the request of G. Porter in anticipation of litigation	WP
1742	88	08/26/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1743	47	08/27/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1744	1	09/24/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1745	20	08/29/2005	Johnson, Mark S.; Balke, Stephen			Testing performed at the request of H. Roper in anticipation of litigation	WP
1746	4	09/28/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1747	4	09/28/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1748	5	09/10/2004	Reichek, Ken	Johnson, Mark S.		Testing performed at the request of counsel in anticipation of litigation	WP

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1749	88	09/14/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1750	49	09/13/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1751	1	09/24/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1752	5	11/02/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1753	5	09/22/2004	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1754	90	09/03/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1755	48	09/04/2004	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1756	1	09/24/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1757	16	09/26/2004	Johnson, Mark S.; Hazlitt, Lonnie			Testing performed at the request of G. Porter in anticipation of litigation	WP
1758	88	09/23/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1759	89	09/24/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1760	88	09/26/2004	Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP
1761	7	09/27/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1762	1	10/15/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1763	7	09/29/2004	Nelson, Mike			Testing performed at the request of G. Porter in anticipation of litigation	WP
1764	4	06/01/2004	Williams, Allen			Testing performed at the request of G. Porter in anticipation of litigation	WP
1765	1	04/22/2004	Williams, Allen	Johnson, Mark S.		Testing performed at the request of G. Porter in anticipation of litigation	WP
1766	1	04/26/2004	Williams, Allen	Johnson, Mark S.		Testing performed at the request of G. Porter in anticipation of litigation	WP
1767	1	05/11/2004	Williams, Allen	Johnson, Mark S.		Testing performed at the request of G. Porter in anticipation of litigation	WP

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1768	4	02/25/2005	Johnson, Mark S.			Testing performed at the request of H. Roper in anticipation of litigation	WP
1769	7	04/26/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1770	1	04/29/2005	Johnson, Mark S.			Testing performed at the request of H. Roper in anticipation of litigation	WP
1771	91	09/24/2003	Reichek, Ken; Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1772	90	09/24/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1773	89	09/24/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1774	89	09/24/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1775	8	01/16/2005	Johnson, Mark S.; Coker, Wayne			Testing performed at the request of H. Roper in anticipation of litigation	WP
1776	8	02/02/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1777	3	02/02/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1778	5	02/02/2005	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of H. Roper in anticipation of litigation	WP
1779	447	11/28/2004	Balke, Stephen			Testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
1780	524	11/28/2004	Balke, Stephen			Testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
1781	118	11/24/2004	Hazlitt, Lonnie			Testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
1782	84	09/2003				Testing performed at the request of counsel in anticipation of litigation	WP
1783	55	09/2003				Testing performed at the request of counsel in anticipation of litigation	WP
1784	88	09/2003				Testing performed at the request of counsel in anticipation of litigation	WP

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1785	2	02/03/2005	Johnson, Mark S.; Hazlitt, Lonnie			Presentation prepared at the request of H. Roper in anticipation of litigation	WP
1786	9	06/23/2004	Johnson, Mark S.			Testing performed at the request of G. Porter in anticipation of litigation	WP
1787	111	09/24/2003	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1788	372	05/06/2005	Johnson, Mark S.; Balke, Stephen			Testing performed at the request of H. Roper in anticipation of litigation	WP
1789	69	03/07/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
1790	68	03/07/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
1791	66	03/07/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
1792	91	03/07/2005	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
1793	5	02/02/2005				Presentation gathered and organized at the request of H. Roper in anticipation of litigation	WP
1794	6	02/02/2005				Presentation gathered and organized at the request of H. Roper in anticipation of litigation	WP
1795	1	08/01/1997	Johnson, Mark S	Swogger, Kurt	Anderson, Kenneth W; Docking, Darrel; McKinney, Ozborne K; Story, Bruce	E-mail correspondence reflecting attorney-client communication with Dow legal department	AC
1796	2	07/09/1997	Lastovica, John	Johnson, Mark S; Anderson, Kenneth W; Chum, Stephen; McKinney, Ozborne K; Docking, Darrel; Lastovica, John	Ellebracht, S; Carrington, S; Schwank, D; Garrett, Gus; Springs, B	E-mail correspondence reflecting attorney-client communications with O. McKinney regarding patent strategy	AC

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1797	2	07/10/1997	Johnson, Mark S	Anderson, Kenneth W; Docking, Darrel; Hazlitt, Lonnie; Huff, Georgia; Jain, Pradeep; Lastovica, John; Mckinney, Ozzie; Schwank, Don; Sehanobish, Kalyan	Carrington, Susan; Chum, Stephen; Ellebracht, Steve; Gambrell, Ed; Holder, Tim; Kao, Che; Korfhage, Glenn; Springs, Bob; Story, Bruce; Swogger, Kurt	E-mail correspondence reflecting attorney-client communications with O. McKinney regarding patent strategy	AC
1798	2	07/09/1997	Lastovica, John	Johnson, Mark S; Anderson, Kenneth W; Chum, Stephen; McKinney, Ozborne K; Docking, Darrel; Lastovica, John	Ellebracht, Steve; Carrington, Susan; Schwank, Don; Garrett, Gus; Springs, B.	E-mail correspondence reflecting attorney-client communications with O. McKinney regarding patent strategy	AC
1799	2	07/11/1997	Johnson, Mark S	Anderson, Kenneth W; ; Hazlitt, Lonnie; Lastovica, John; Schwank, D; Holder, Tim; McKinney, Ozborne K; Docking, Darrel; Huff, Georgia; Sehanobish, Kalyan; Jain, Pradeep	Chum, Stephen; Ellebracht, S; Story, Bruce; Carrington, S; Holder, Tim; Kao, C; Springs, B; Korfhage, Glenn; Swogger, Kurt W; Gambrell, E	E-mail correspondence reflecting attorney-client communications with O. McKinney regarding patent strategy	AC
1800	2	070/9/1997	Lastovica, John	Johnson, Mark S; Anderson, Kenneth W; Chum, Stephen; McKinney, Ozborne K; Docking, Darrel; Lastovica, John	Ellebracht, S; Carrington, S; Schwank, Don; Garrett, Gus; Springs, B	E-mail correspondence reflecting attorney-client communications with O. McKinney regarding patent strategy	AC
1801	1	08/05/1997	McKinney, Ozborne K; Story, Bruce; Johnson, Mark S	Story, Bruce; Swogger, Kurt W; Johnson, Mark S	Anderson, Kenneth W; Docking, Darrel; Jain, Pradeep; Johnson, Mark S; Kao, Che; McKinney, Ozborne K; Story, Bruce	E-mail correspondence providing legal advice regarding patent application	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1802	3	09/18/1997	Goldener, Beatrice; Docking, Darrel; Story, Bruce; Krupp, Stephen; Zuercher, Regula	Docking, Darrel; Story, Bruce; Krupp, Stephen; Goldener, Beatrice; Langworthy, John; Zuercher, Regula	De Jonge, Nicolaas; Dyball, Christopher; Hazlitt, Lonnie; Johnson, Mark S; Kalil, Charles; Korfhage, Glenn; Krupp, Stephen; Langworthy, John; Goldener, Beatrice	E-mail correspondence providing legal advice and reflecting attorney-client communications with S. Krupp and N. DeJonge	AC
1803	1	11/14/1997	Mcnamee, Gary	Johnson, Mark S		E-mail correspondence attaching information requested by Legal Dept in anticipation of prior litigation	WP
1804	8	11/14/1997	Gary McNamee			Attached report providing information requested by Legal Dept in anticipation of prior litigation	WP
1805	1	11/14/1997	Mcnamee, Gary	Johnson, Mark S		E-mail correspondence attaching information requested by Legal Dept in anticipation of prior litigation	WP
1806	2	11/14/1997				Attached report providing information requested by Legal Dept in anticipation of prior litigation	WP
1807	1	10/20/1997	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Hazlitt, Lonnie; Huff, Georgia; Karjala, Teresa; Krupp, Stephen; Langworthy, John; Mckinney, Ozzie; Parrott, Albert; Stevens, James; Warrick, Noreen	Docking, Darrel; Story, Bruce; Stuart, Duncan	E-mail correspondence proposing discussion regarding patent technology in anticipation of prior litigation	WP
1808	1	12/12/1997	Johnson, Mark S	deGroot, A Willem; Dubois, Robert; Hazlitt, Lonnie; Huff, Georgia; Kale, Larry; Karjala, Teresa; Krupp, Stephen; Langworthy, John; Mckinney, Ozzie; Parrott, Albert; Stevens, James; Warrick, John	Chum, Stephen; Docking, Darrel; Montanye, Jeff; Story, Bruce; Stuart, Duncan	E-mail correspondence summarizing discussion of patent technology in anticipation of prior litigation	WP

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1809	2	10/28/1997	Hazlitt, Lonnie	Chum, Stephen; deGroot, A Willem; Dubois, Robert; Huff, Georgia; Johnson, Mark S; Kale, Larry; Karjala, Teresa; Krupp, Stephen; Langworthy, John; Mckinney, Ozzie; Parrott, Albert; Stevens, James; Warrick, Noreen	Docking, Darrel; Montanye, Jeff; Story, Bruce; Stuart, Duncan	E-mail correspondence regarding information requested by Legal Dept in anticipation of prior litigation	WP
1810	1	11/04/1997	Mcnamee, Gary	Johnson, Mark S		E-mail correspondence attaching information requested by Legal Dept in anticipation of prior litigation	WP
1811	18	11/04/1997	Mcnamee, Gary	Johnson, Mark S		Attached report providing information requested by Legal Dept in anticipation of prior litigation	WP
1812	1	11/04/1997	Mcnamee, Gary	Johnson, Mark S		E-mail correspondence attaching information requested by Legal Dept in anticipation of prior litigation	WP
1813	21	11/04/1997	Mcnamee, Gary	Johnson, Mark S		Attached report providing information requested by Legal Dept in anticipation of prior litigation	WP
1814	1	03/26/1998	Lai, Shih-Yaw	Guarino, Carlo; Johnson, Mark S; Krupp, Stephen; Wildi, Markus	Chum, Stephen; Dupont, Andy; Ellebracht, Steve; Frencham, Tony; Lai, Shih-Yaw; Ogawa, Katsuhiro; Su, Martin	E-mail correspondence with attached report sent to counsel in order to obtain legal advice	AC
1815	4	03/24/1998				Removed and produced	
1816	1	10/27/1997	Kale, Larry	deGroot, A Willem Parrott, Albert	Huff, Georgia; Johnson, Mark S; Lastovica, John; McKinney, Ozborne K	E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP
1817	1	10/27/1997	Kale, Larry	deGroot, A Willem;; Parrott, Al	Johnson, Mark S; Huff, G; McKinney, Ozborne K; Lastovica, John	Correspondence regarding testing requested by counsel in anticipation of prior litigation	WP

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1818	1	10/20/1997	Langworthy, John	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Docking, Darrel; Hazlitt, Lonnie; Huff, Georgia; Karjala, Teresa; Krupp, Stephen; McKinney, Ozborne K; Parrott, Albert; Stevens, James; Story, Bruce; Stuart, Duncan; Warrick, Noreen	E-mail correspondence requesting legal advice and providing information in anticipation of prior litigation	AC, WP
1819	1	07/02/1997	Lastovica, John; Kale, Larry	Johnson, Mark S; Chum, Stephen; McKinney, Ozborne K; Markovich, Ronald P; Lastovica, John; Lai, Shih-Yaw		E-mail correspondence providing attached information in order to obtain legal advice in anticipation of prior litigation	AC, WP
1820	2	07/02/1997	Kale, Larry	Chum, Stephen; McKinney, Ozborne K; Markovich, Ronald P; Lastovica, John; Lai, Shih-Yaw		Attached information provided in order to obtain legal advice and reflecting results of testing performed in anticipation of prior litigation	AC, WP
1821	2	07/29/1998	McKinney, Ozborne K	Docking, Darrel; Johnson, Mark S; Story, Bruce		E-mail correspondence providing legal advice regarding patent application in anticipation of prior litigation	AC, WP
1822	1	08/25/1997	Johnson, Mark S	Huff, Georgia; Parrott, Albert	Ehrhart, Sabra; Fisher, Patricia	E-mail correspondence regarding work performed at the request of counsel in anticipation of prior litigation	WP
1823	1	10/28/1997	Mcnamee, Gary	Johnson, Mark S		E-mail correspondence providing attached information requested by counsel in anticipation of prior litigation	WP
1824	2	10/28/1997		Johnson, Mark S		Attached information provided at the request of counsel in anticipation of prior litigation	WP
1825	1	10/28/1997		Johnson, Mark S		Attached information provided at the request of counsel in anticipation of prior litigation	WP

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1826	3	10/28/1997		Johnson, Mark S		Attached information provided at the request of counsel in anticipation of prior litigation	WP
1827	3	06/16/1999	Anderson, Kenneth	Mckinney, Ozzie	Allgeuer, Thomas; Chum, Stephen; Dyball, Christopher; Johnson, Mark S; Lastovica, John; Schrock, Nancy; Von Cunow, Dorothee	E-mail correspondence providing information requested by patent counsel in order to provide legal advice and containing legal advice of O. McKinney	AC
1828	2	10/20/1997	Hazlitt, Lonnie; Johnson, Mark S	Johnson, Mark S; Chum, Stephen; Degroot, Jackie; Hazlitt, Lonnie; Huff, Georgia; Karjala, Teresa; Krupp, Stephen; Langworthy, John; McKinney, Ozborne K; Parrott, Albert; Stevens, James; Warrick, Noreen D	Docking, Darrel; Krupp, Stephen; Langworthy, John; McKinney, Ozborne K; Parrott, Albert; Story, Bruce; Stuart, Duncan; Warrick, Noreen	E-mail correspondence requesting legal advice and providing information in order to obtain legal advice in anticipation of prior litigation	AC, WP
1829	1	10/20/1997	Story, Bruce; Johnson, Mark S	Johnson, Mark S; Chum, Stephen; Degroot, Willem; Hazlitt, Lonnie; Huff, Georgia; Karjala, Teresa; Krupp, Stephen; Langworthy, John; McKinney, Ozborne K; Parrott, Albert; Stevens, James; Warrick, Noreen D		E-mail correspondence requesting legal advice and providing information in order to obtain legal advice in anticipation of prior litigation	AC, WP
1830	2	10/27/1997	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Dubois, Robert; Hazlitt, Lonnie; Huff, Georgia; Kale, Larry; Karjala, Teresa; Krupp, Stephen; Langworthy, John; Mckinney, Ozzie; Parrott, Albert; Stevens, James; Warrick, Noreen	Docking, Darrel; Montanye, Jeff; Story, Bruce; Stuart, Duncan	E-mail correspondence requesting legal advice and setting an agenda for a meeting to obtain legal advice in anticipation of prior litigation	AC, WP

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1831	2	10/20/1997	McKinney, Ozborne K	Hazlitt, Lonnie; Johnson, Mark S	Docking, Darrel; Krupp, Stephen; Langworthy, John; Parrott, Albert; Story, Bruce; Stuart, Duncan; Warrick, Noreen	E-mail correspondence requesting information in order to provide legal advice in anticipation of prior litigation	AC, WP
1832	2	10/29/1997	Johnson, Mark S	Chum, Stephen; deGroot, A Willem; Dubois, Robert; Hazlitt, Lonnie; Huff, Georgia; Kale, Larry; Karjala, Teresa; Krupp, Stephen; Langworthy, John; Mckinney, Ozzie; Parrott, Albert; Stevens, James; Warrick, Noreen	Docking, Darrel; Montanye, Jeff; Story, Bruce; Stuart, Duncan	E-mail correspondence providing information in order to obtain legal advice in anticipation of prior litigation	AC, WP
1833	2	03/26/1998	Chum, Stephen; Lai, Shih-Yaw	Johnson, Mark S; Lai, Shih-Yaw; Wildi, Markus; Guarino, Carlo; Krupp, Stephen	Dupont, Andy; Ellebracht, Steve; Frencham, Tony; Guarino, Carlo; Kale, Larry; Krupp, Stephen; McKinney, Ozborne K; Ogawa, Katsuhiro; Story, Bruce; Stuart, Duncan; Su, Martin; Wildi, Markus	E-mail correspondence regarding assessments requested by counsel in anticipation of prior litigation	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1834	2	03/26/1998	Johnson, Mark S	Lai, Shih-Yaw	Chum, Stephen; Dupont, Andy; Ellebracht, Steve; Frencham, Tony; Guarino, Carlo; Kale, Larry; Krupp, Stephen; McKinney, Ozborne K; Ogawa, Katsuhiro; Story, Bruce; Stuart, Duncan; Su, Martin; Wildi, Markus	E-mail correspondence regarding assessments requested by counsel in anticipation of prior litigation	AC, WP
1835	3	03/26/1998	McKinney, Ozborne K	Chum, Stephen; Johnson, Mark S; Lai, Shih-Yaw	Dupont, Andy; Ellebracht, Steve; Frencham, Tony; Guarino, Carlo; Kale, Larry; Krupp, Stephen; Ogawa, Katsuhiro; Story, Bruce; Stuart, Duncan; Su, Martin; Wildi, Markus	E-mail correspondence providing legal advice regarding patent prosecution and analysis prepared in anticipation of prior litigation	AC, WP
1836	1	07/17/1997	Chum, Stephen	Carrington, Susan; Ellebracht, Steve; Illge, Alex; Springs, Bob; Swogger, Kurt; Torres, Antonio; Walsh, Leonie	Johnson, Mark S	E-mail correspondence regarding assessments prepared at the request of counsel in anticipation of prior litigation	WP
1837	1	10/28/1997	Kale, Larry	Johnson, Mark S		E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP
1838	1	10/06/1997	Johnson, Mark S; McKinney, Ozborne K	Mckinney, Ozzie; Gambrell, Ed; Swogger, Kurt W.; Kalil, Charles		E-mail correspondence containing legal advice regarding patent application in anticipation of prior litigation	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1839	2	10/17/1997	Johnson, Mark S	Huff, Georgia; Kale, Larry; Parrott, Albert	Chum, Stephen; deGroot, A Willem; Ehrhart, Sabra; Ellebracht, Steve; Hazlitt, Lonnie; Krupp, Stephen; McKinney, Ozborne K; Patel, Rajen; Story, Bruce; Stuart, Duncan	E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP
1840	2	10/20/1997	Krupp, Stephen	Mckinney, Ozzie	Chum, Stephen; Johnson, Mark S; Korfhage, Glenn; Stuart, Duncan	E-mail correspondence providing legal advice reflecting previous patent prosecution in anticipation of prior litigation	AC, WP
1841	1	08/21/1997	Chum, Stephen	Gambrell, Ed; Kalil, Charles; Story, Bruce; Swogger, Kurt	Carrington, Susan; Docking, Darrel; Johnson, Mark S; Korfhage, Glenn; Krupp, Stephen; McKinney, Ozborne K	E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP
1842	1	11/19/1997	Krupp, Stephen	Johnson, Mark S		E-mail correspondence regarding attached privileged testing requested by counsel in anticipation of prior litigation	WP
1843	130	11/19/1997	Winter, J. Mark			Attached privileged testing requested by counsel in anticipation of prior litigation	WP
1844	1	11/19/1997				Attached privileged testing requested by counsel in anticipation of prior litigation	WP
1845	12	11/19/1997				Attached privileged testing requested by counsel in anticipation of prior litigation	WP
1846	27	11/19/1997	na			Attached privileged testing requested by counsel in anticipation of prior litigation	WP
1847	26	11/19/1997	Winter, J. Mark			Attached privileged testing requested by counsel in anticipation of prior litigation	WP

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1848	1	09/05/1997	Johnson, Mark S	Huff, Georgia; Kale, Larry; Parrott, Albert	Chum, Stephen; Ehrhart, Sabra; Ellebracht, Steve; Krupp, Stephen; McKinney, Ozborne K; Patel, Rajen; Story, Bruce	E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP
1849	1	08/28/1997	Johnson, Mark S	Huff, Georgia; Kale, Larry; Parrott, Albert	Patel, Rajen	E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP
1850	2	09/26/1997	Johnson, Mark S	Huff, Georgia; Kale, Larry; Parrott, Albert	Chum, Stephen; deGroot, A Willem; Ehrhart, Sabra; Ellebracht, Steve; Hazlitt, Lonnie; Krupp, Stephen; McKinney, Ozborne K; Patel, Rajen; Story, Bruce; Stuart, Duncan	E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP
1851	1	08/26/1997	Johnson, Mark S	Huff, Georgia; Parrott, Albert; Patel, Rajen	Chum, Stephen; deGroot, A Willem; Ehrhart, Sabra; Ellebracht, Steve; Kale, Larry; Krupp, Stephen; McKinney, Ozborne K; Story, Bruce	E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP
1852	1	08/20/1997	Story, Bruce	Gambrell, Ed; Kalil, Charles; Swogger, Kurt	Carrington, Susan; Chum, Stephen; Docking, Darrel; Johnson, Mark S; Korfhage, Glenn; Krupp, Stephen; McKinney, Ozborne K	E-mail correspondence regarding testing requested by counsel in anticipation of prior litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1853	1	11/25/1997	Johnson, Mark S	Krupp, Stephen; Mckinney, Ozzie; Stuart, Duncan		E-mail correspondence requesting legal advice regarding patent strategy	AC
1854	122	11/04/2004	Johnson, Mark S			Presentation prepared at the request of G. Porter in anticipation of litigation	WP
1855	113	05/03/2004	Johnson, Mark S; Krupp, Stephen; Glenn, Michael L			Presentation prepared at the request of G. Porter in anticipation of litigation	WP
1856	50	06/03/2004	Johnson, Mark S			Presentation prepared at the request of G. Porter in anticipation of litigation	WP
1857	16	01/30/2005	Johnson, Mark S			Testing performed at the request of H. Roper in anticipation of litigation	WP
1858	2	07/18/2003	Johnson, Mark S	Anderson, Kenneth W; Bernier, Robert; Cobler, Brad; Crim, Brad; deGroot, A Willem; Dekunder, Staci; Dowling, Nicole; Eversdyk, David; Fordyce, William; Gillespie, David; Hazlitt, Lonnie; Jain, Pradeep; Karjala, Teresa; Koch, Kaelyn; Kolthammer, Brian; Krupp, Stephen; Mcconnell, Dennis; Niemann, Debra; Ramsey, David; Sehanobish, Kalyan; Story, Bruce; Wooster, Jeffrey	Turk, Thelma	Removed because duplicate of #240	
1859	29	08/18/2003	Johnson, Mark S; Billings, Mike; Dekunder, Staci; Larsen, Doug; McConnell, Dennis; Niemann, Debra; Nietvelt, Paul, Patterson, Leree; Wright, Glenn			Presentation prepared at the request of M. Glenn in anticipation of litigation	WP

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1860	15	08/04/2003	Johnson, Mark S; Billings, Mike; Dekunder, Staci; Larsen, Doug; McConnell, Dennis; Niemann, Debra; Nietvelt, Paul, Patterson, Leree; Wright, Glenn			Presentation prepared at the request of M. Glenn in anticipation of litigation	WP
1861	2	06/2004	Fordyce, William; Johnson, Mark S.			Presentation prepared at the request of G. Porter in anticipation of litigation	WP
1862	43	04/15/2004	Johnson, Mark S			Presentation prepared at the request of G. Porter in anticipation of litigation	WP
1863	1	08/26/2003	Johnson, Mark S			Agenda prepared at the request of M. Glenn in anticipation of litigation	WP
1864	2	09/02/2003	Dekunder, Staci	Anderson, Kenneth W; Crim, Brad; Hazlitt, Lonnie; Jain, Pradeep; Johnson, Mark S; Niemann, Debra; Sehanobish, Kalyan		E-mail correspondence attaching test results collected at the request of M. Glenn in anticipation of litigation	WP
1865	17	09/02/2003	Dekunder, Staci			Attached test results provided at the request of M. Glenn in anticipation of litigation	WP
1866	31	11/10/2004	Johnson, Mark S			Presentation prepared at the request of H. Roper in anticipation of litigation	WP
1867	4	02/25/2005 - 03/24/2005	Johnson, Mark S.			Testing performed at the request of H. Roper in anticipation of litigation	WP
1868	5	02/09/2005 - 02/14/2005	Johnson, Mark S.			Testing collected and/or performed in anticipation of litigation and analyzed at the request of H. Roper in anticipation of litigation	WP
1869	1	04/05/2006	Johnson, Mark S.			Draft notes prepared at the request of H. Roper in anticipation of litigation	WP
1870	2	03/03/2006 - 03/08/2006	Johnson, Mark S.			Draft notes prepared at the request of H. Roper in anticipation of litigation	WP

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1871	2	03/03/2006	Johnson, Mark S.			Draft notes prepared at the request of H. Roper in anticipation of litigation	WP
1872	2	03/08/2006	Johnson, Mark S.			Presentation slide regarding testing performed on 6/1/2004 at the request of H. Roper in anticipation of litigation	WP
1873	5	01/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
1874	2	01/14/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
1875	2	01/14/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
1876	13	01/26/2005	Jones, Laura			Testing performed at the request of H. Roper in anticipation of litigation	WP
1877	13	01/26/2005	Jones, Laura			Testing performed at the request of H. Roper in anticipation of litigation	WP
1878	13	01/26/2005	Jones, Laura			Testing performed at the request of H. Roper in anticipation of litigation	WP
1879	28	01/26/2005	Jones, Laura			Testing performed at the request of H. Roper in anticipation of litigation	WP
1880	90	01/26/2005		Johnson, Mark S.		Testing performed at the request of H. Roper in anticipation of litigation	WP
1881	90	01/26/2005		Johnson, Mark S.		Testing performed at the request of H. Roper in anticipation of litigation	WP
1882	90	01/26/2005		Johnson, Mark S.		Testing performed at the request of H. Roper in anticipation of litigation	WP
1883	64	01/17/2005	Hazlitt, Lonnie; Johnson, Mark S	Jones, Laura		Testing performed at the request of H. Roper in anticipation of litigation	WP
1884	1	01/18/05 - 01/26/05	Nelson, Mike			Presentation slide regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1885	1	01/18/05 - 01/26/05	Nelson, Mike			Presentation slides regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1886	1	01/24/2005	Achten, Lisa	Jones, Laura		Report summary regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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1887	1	01/21/2005	Potter, Janece	Jones, Laura		Report summary regarding testing performed at the request of H. Roper in anticipation of litigation	WP
1888	1	02/03/2005	Yusuf, Siaka	Johnson, Mark S; Jones, Laura		E-mail correspondence regarding attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1889	2	02/03/2005	Yusuf, Siaka			Attached privileged testing performed at the request of H. Roper in anticipation of litigation	WP
1890	1	01/26/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
1891	1	01/26/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
1892	1	01/26/2005				Testing performed at the request of H. Roper in anticipation of litigation	WP
1893	12	01/18/2005	Jones, Laura			Testing performed at the request of H. Roper in anticipation of litigation	WP
1894	1	05/12/2005	Johnson, Mark S			Draft technology presentation prepared at the request of M. Glenn in anticipation of litigation	WP
1895	19	05/25/2005	Johnson, Mark S			Draft technology presentation prepared at the request of M. Glenn in anticipation of litigation	WP
1896	39	05/13/2005	Johnson, Mark S			Presentation regarding technology prepared at the request of H. Roper and B. Kanuch in anticipation of litigation reflecting attorney-client communications with Mark Johnson	AC, WP
1897	36	05/13/2005	Johnson, Mark S			Presentation regarding technology prepared at the request of H. Roper and B. Kanuch in anticipation of litigation reflecting attorney-client communications with Mark Johnson	AC, WP

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1898	70	05/25/2005	Johnson, Mark S			Presentation regarding technology prepared at the request of H. Roper and B. Kanuch in anticipation of litigation reflecting attorney-client communications with Mark Johnson	AC, WP
1899	46	04/08/2005	Johnson, Mark S	Schwartz, Roger		Presentation regarding patent enforcement prepared at the request of M. Glenn in anticipation of litigation	WP
1900	26	04/08/2005	Johnson, Mark S; Kanuch, Bruce M	Schwartz, Roger		Presentation prepared by B. Kanuch and M. Johnson in anticipation of litigation providing legal advice of B. Kanuch	AC, WP
1901	2	04/18/2005	Johnson, Mark S			Notes prepared at the request of H. Roper in anticipation of litigation	WP
1902	40	08/22/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1903	40	08/22/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1904	15	05/08/2005 - 05/12/2005	Johnson, Mark S			Testing performed at the request of H. Roper in anticipation of litigation	WP
1905	2	09/28/2006	Johnson, Mark S			Testing performed at the request of H. Roper in anticipation of litigation	WP
1906	4	02/07/2005	Johnson, Mark S			Spreadsheet containing financial analysis regarding patent enforcement strategy generated at request of M. Glenn in anticipation of litigation.	WP
1907	26	02/14/2005	Johnson, Mark S			Presentation prepared at the request of M. Glenn in anticipation of litigation	WP
1908	1	02/04/2005	Johnson, Mark S			Notes prepared at the request of counsel in anticipation of litigation and reflecting legal advice of M. Glenn	AC, WP
1909	22	04/14/2005	Kanuch, Bruce M			Presentation prepared by counsel in anticipation of litigation providing legal advice to management	AC, WP
1910	12	04/03/2005	Kanuch, Bruce M			Draft presentation prepared by counsel in anticipation of litigation providing legal advice	WP

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1911	22	04/14/2005	Kanuch, Bruce M			Presentation prepared by counsel in anticipation of litigation providing legal advice to management	AC, WP
1912	3	04/11/2005	Kanuch, Bruce M			Report prepared by counsel in anticipation of litigation providing legal advice to management	AC, WP
1913	26	04/08/2005	Johnson, Mark S; Kanuch, Bruce M	Schwartz, Roger		Presentation prepared by counsel in anticipation of litigation providing legal advice of B. Kanuch	AC, WP
1914	6	04/08/2005	Johnson, Mark S; Kanuch, Bruce M			Draft presentation prepared by counsel in anticipation of litigation providing legal advice of B. Kanuch, Esq.	WP
1915	36	06/10/2004	Johnson, Mark S			Presentation prepared at the request of counsel in anticipation of litigation	WP
1916	11					Removed and produced	
1917	6					Removed and produced	
1918	4					Removed and produced	
1919	7					Removed and produced	
1920	11					Removed and produced	
1921	11					Removed and produced	
1922	6					Removed and produced	
1923	9					Removed and produced	
1924	7					Removed and produced	
1925	11					Removed and produced	
1926	1	04/19/2004	Johnson, Mark S; Markovich, Ronald P			Notes prepared at the request of counsel in anticipation of litigation	WP
1927	2	02/09/2005	Markovich, Ronald P			Notes reflecting attorney-client communications with O. McKinney regarding action items for testing in support of patent application	AC
1928	4	10/02/2003 - 10/06/2003	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1929	4	06/14/2005	Johnson, Mark S.			Testing performed at the request of H. Roper in anticipation of litigation	WP
1930	4	06/13/2004	Johnson, Mark S.; Reichek, Ken			Testing performed at the request of G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1931	1	10/03/2005 - 10/25/2005	Balke, Stephen T			Report prepared at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1932	11	10/03/2005	Balke, Stephen T			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1933	21	08/22/2005	Balke, Stephen T			Test analysis performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1934	21	08/22/2005	Balke, Stephen T			Test analysis performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1935	21	08/22/2005	Balke, Stephen T			Test analysis performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1936	21	08/22/2005	Balke, Stephen T			Test analysis performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1937	9	09/03/2005	Balke, Stephen T			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1938	25	08/22/2005	Balke, Stephen T			Test analysis performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1939	25	08/22/2005	Balke, Stephen T			Test analysis performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1940	116	09/22/2004	Balke, Stephen T			Testing performed at the request of M. Glenn and G. Porter in anticipation of litigation	WP
1941	70	08/22/2005	Balke, Stephen T			Test analysis performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1942	88	09/18/2004	Balke, Stephen T.			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1943	9	10/24/2004	Balke, Stephen T.; Johnson, Mark S.			Testing performed at the request of M. Glenn and G. Porter in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1944	356	11/18/2004 - 05/06/2005	Balke, Stephen T.			Testing performed at the request of M. Glenn, G. Porter, and H. Roper in anticipation of litigation	WP
1945	66	03/07/2005	Balke, Stephen T; Reichek, Ken			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1946	69	10/16/2005	Balke, Stephen T; Reichek, Ken			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1947	70	10/16/2005	Balke, Stephen T; Reichek, Ken			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1948	392	09/17/2005	Balke, Stephen T.			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1949	101	09/14/2005	Balke, Stephen T.			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1950	6	11/02/2005	Balke, Stephen T.			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1951	116	09/22/2004	Balke, Stephen T; Reichek, Ken			Testing performed at the request of M. Glenn and G. Porter in anticipation of litigation	WP
1952	70	08/22/2005	Balke, Stephen T			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1953	11	09/04/2005	Balke, Stephen T			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1954	21	08/22/2005	Balke, Stephen T			Testing performed at the request of M. Glenn and H. Roper in anticipation of litigation	WP
1955	3	12/16/2003	Johnson, Mark S.			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1956	14					Removed and produced	
1957	14					Removed and produced	
1958	14					Removed and produced	

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1959	14					Removed and produced	
1960	14					Removed and produced	
1961	14					Removed and produced	
1962	1	08/16/2003	Johnson, Mark S.			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1963	14					Removed and produced	
1964	14					Removed and produced	
1965	14					Removed and produced	
1966	39					Removed and produced	
1967	22					Removed and produced	
1968	3					Removed and produced	
1969	110	07/18/2003 - 04/14/2005	Gibbons, Julie			Testing performed at the request of G. Porter, H. Roper, and M. Glenn and compiled in anticipation of litigation	WP
1970	315					Removed and produced	
1971	2	04/14/2005	Johnson, Mark S.			Presentation slides regarding testing performed at the request of counsel in anticipation of litigation	WP
1972	98					Removed and produced	
1973	78					Removed and produced	
1974	28	09/04/2003	Johnson, Mark S; Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1975	28	09/04/2003	Johnson, Mark S; Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1976	24	09/04/2003	Johnson, Mark S; Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1977	40	09/02/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1978	40	08/22/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1979	40	09/02/2003	Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1980	43	11/18/2004	Johnson, Mark S; Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1981	42	08/22/2003	Johnson, Mark S; Hazlitt, Lonnie			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1982	3	11/04/2003	Perkins, Harolyn L.	Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP

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1983	3	11/04/2003	Perkins, Harolyn L.	Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
1984	1	12/07/2003	Gillespie, David			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1985	2	12/07/2003	Gillespie, David			Testing performed at the request of M. Glenn in anticipation of litigation	WP
1986	1	09/11/2003	Huang, Joe	Johnson, Mark S	Huang, Joe	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
1987	3	09/11/2003	Huang, Joe	Johnson, Mark S	Huang, Joe	Testing performed at the request of M. Glenn in anticipation of litigation	WP
1988	2	06/25/2003 - 09/11/2003	Huang, Joe; Johnson, Mark S	Johnson, Mark S	Huang, Joe	Removed and produced	
1989	1	08/04/2003	Huang, Joe	Johnson, Mark S	Huang, Joe; Karjala, Teresa	Removed and produced	
1990	11	06/25/2003	Huang, Joe; Johnson, Mark S	Johnson, Mark S	Huang, Joe; Karjala, Teresa	Removed and produced	
1991	6	04/05/2007	Johnson, Mark S			Testing performed at the request of H. Roper in anticipation of litigation	WP
1992	101	10/10/06 - 10/11/06	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
1993	47	10/19/2006	Parrott, Albert; Johnson, Mark S			Testing performed at the request of H. Roper in anticipation of litigation	WP
1994	98	10/10/06 - 10/11/06	Hazlitt, Lonnie			Testing performed at the request of H. Roper in anticipation of litigation	WP
1995	4	10/30/2006	Coker, Wayne; Johnson, Mark S			Testing performed at the request of H. Roper in anticipation of litigation	WP
1996	4	10/30/2006	Coker, Wayne; Parrott, Albert			Testing performed at the request of H. Roper in anticipation of litigation	WP
1997	2	10/00/2006	Martin, Patrick			Testing performed at the request of H. Roper in anticipation of litigation	WP
1998	1	03/24/2005	Oswald, Thomas	Johnson, Mark S		E-mail correspondence regarding and attaching modeling performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
1999	5	03/24/2005	Oswald, Thomas	Johnson, Mark S		Attached modeling performed at the request of H. Roper in anticipation of litigation	WP
2000	1047	08/18/2003	Gillespie, David			Testing performed at the request of M. Glenn in anticipation of litigation	WP
2001	1050	08/18/2003	Gillespie, David			Testing performed at the request of M. Glenn in anticipation of litigation	WP
2002	1050	08/18/2003	Gillespie, David			Testing performed at the request of M. Glenn in anticipation of litigation	WP
2003	39	08/18/2003	Gillespie, David			Testing performed at the request of M. Glenn in anticipation of litigation	WP
2004	6	11/16/2004	Johnson, Mark S			Presentation regarding testing performed at the request of counsel in anticipation of litigation	WP
2005	1	11/18/2003	Johnson, Mark S	Beil, Robert; Fordyce, William; Glenn, Michael L; Kreinberg, Romeo; Schwartz, Roger; Sexton, Diane; Story, Bruce; Swogger, Kurt; Vanderhider, Alan	Anderson, Kenneth W; Bernier, Robert; Billings, Mike; deGroot, A Willem; Dekunder, Staci; Gillespie, David; Hazlitt, Lonnie; Koch, Kaelyn; Kolthammer, Brian; Krupp, Stephen; Larsen, Douglas; Mcconnell, Dennis; Michie, William; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Reichek, Ken; Sehanobish, Kalyan; Williams, Allen; Wright, Glenn	E-mail correspondence to M. Glenn regarding testing performed at the request of M. Glenn in anticipation of litigation	AC, WP
2006	1	04/28/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken; Zhou, Zhe	E-mail correspondence regarding testing performed at the request of counsel in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2007	2	04/28/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken; Zhou, Zhe	Report of testing performed at the request of counsel in anticipation of litigation	WP
2008	1	10/02/2003	Reichek, Ken	Johnson, Mark S		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
2009	4	10/02/2003	Reichek, Ken	Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP
2010	1	08/31/2004	Yusuf, Siaka	Fmdmas; Johnson, Mark S; Reichek, Ken		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2011	1	08/31/2004		Reichek, Ken; Johnson, Mark S		Testing performed at the request of G. Porter in anticipation of litigation	WP
2012	1	11/03/2004	Rigot, Ward	Fmdmas,; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
2013	2	11/03/2004		Johnson, Mark S		Testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP
2014	1	01/27/2005	Johnson, Mark S	Kanuch, Bruce	Krupp, Stephen	E-mail correspondence to counsel regarding attached draft presentation prepared at the request of counsel in anticipation of litigation in order to obtain legal advice regarding patent infringement	AC, WP
2015	13	02/16/2005	Johnson, Mark S	Kanuch, Bruce	Krupp, Stephen	Attached draft presentation prepared at the request of M. Glenn in anticipation of litigation provided in order to obtain legal advice regarding patent infringement	AC, WP
2016	1	02/05/2005	Johnson, Mark S	Kanuch, Bruce		E-mail correspondence to M. Glenn regarding attached notes prepared at the request of M. Glenn in anticipation of litigation in order to obtain legal advice regarding patent infringement	AC, WP

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2017	1	02/04/2005	Johnson, Mark S	Kanuch, Bruce		Attached notes prepared at the request of M. Glenn in anticipation of litigation and provided in order to obtain legal advice regarding patent infringement	AC, WP
2018	1	02/12/2005	Johnson, Mark S	Story, Bruce		E-mail correspondence regarding attached presentation prepared at the request of M. Glenn in anticipation of litigation	WP
2019	26	02/14/2005	Johnson, Mark S	Story, Bruce		Presentation prepared at the request of S. Krupp in anticipation of litigation regarding patent infringement	WP
2020	1	12/19/2003	Krupp, Stephen	Johnson, Mark S		E-mail correspondence providing legal advice regarding patent application	AC
2021	1	08/25/2004	Coker, Wayne	Hazlitt, Lonnie	Coker, Wayne; Johnson, Mark S; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2022	2	02/06/2004	Johnson, Mark S	Porter, Greg	Hazlitt, Lonnie; Krupp, Stephen	E-mail correspondence regarding attached documents in order to obtain legal advice regarding patent infringement in anticipation of litigation	AC, WP
2023	6	02/06/2004	Hazlitt, Lonnie	Warrick, Noreen D; Porter, Greg	Hazlitt, Lonnie; Krupp, Stephen	Attached draft correspondence prepared at the request of an attorney provided to counsel in order to obtain legal advice regarding patent infringement	AC, WP
2024	25	02/06/2004				Removed and produced	
2025	8	02/06/2004		Porter, Greg	Hazlitt, Lonnie; Krupp, Stephen	Attached patent provided to counsel in order to obtain legal advice regarding patent infringement	AC
2026	15	02/06/2004		Porter, Greg	Hazlitt, Lonnie; Krupp, Stephen	Attached article provided to counsel in order to obtain legal advice regarding patent infringement	AC
2027	2	09/03/2004	Hazlitt, Lonnie	Reichek, Ken	Johnson, Mark S	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2028	1	06/17/2005	Coker, Wayne	Johnson, Mark S	Coker, Wayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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2029	1	02/08/2005	Johnson, Mark S	Kanuch, Bruce		E-mail correspondence regarding analyses prepared at the request of B. Kanuch in anticipation of litigation in order to obtain legal advice regarding patent infringement	AC, WP
2030	4	02/07/2005	Johnson, Mark S	Kanuch, Bruce		Analysis prepared at the request of counsel in anticipation of litigation in order to obtain legal advice regarding patent infringement	AC, WP
2031	1	02/08/2005	Johnson, Mark S	Kanuch, Bruce		Analysis prepared at the request of B. Kanuch in anticipation of litigation in order to obtain legal advice regarding patent infringement	AC, WP
2032	1	02/25/2005	Johnson, Mark S	Oswald, Thomas		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2033	4	02/25/2005	Johnson, Mark S	Oswald, Thomas		Testing performed at the request of H. Roper in anticipation of litigation	WP
2034	1	03/07/2006	Hazlitt, Lonnie	Johnson, Mark S		E-mail attaching testing performed at the request of H. Roper in anticipation of litigation	WP
2035	91	03/07/2006	Hazlitt, Lonnie	Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
2036	1	07/02/2003	Huang, Joe	Johnson, Mark S	Costeux, Stephane; Huang, Joe; Karjala, Teresa; Peters, Herbert; Reichek, Ken	Removed and produced	
2037	16	06/04/2003 - 06/30/2003	Huang, Joe	Johnson, Mark S	Costeux, Stephane; Huang, Joe; Karjala, Teresa; Peters, Herbert; Reichek, Ken	Removed and produced	

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2038	1	03/17/2005	Johnson, Mark S	Anderson, Kenneth W; Bellmore, David; Cotton, Robert; Dekunder, Staci; Heard, Mark; Kardos, Lori; Niemann, Debra; Weeks, Ron; Wooster, Jeffrey		E-mail correspondence requesting and collecting competitive analysis data in anticipation of litigation	WP
2039	1	03/31/2005	Johnson, Mark S	Anderson, Kenneth W; Bellmore, David; Cotton, Robert; Dekunder, Staci; Heard, Mark; Kardos, Lori; Niemann, Debra; Weeks, Ron; Wooster, Jeffrey		E-mail correspondence requesting and collecting competitive analysis data in anticipation of litigation	WP
2040	1	03/04/2005	Johnson, Mark S	Conboy, Claire	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
2041	2	12/22/2004	Kanuch, Bruce M; (Nicholas, Gloria)	Anderson, Kenneth W; Cardwell, Scott; Chum, Stephen; Coker, Wayne; Dekunder, Staci; Fordyce, William; Hazlitt, Lonnie; Johnson, Mark S; Kolthammer, Brian; Krupp, Stephen; Lai, Shih-Yaw; Larsen Jr, Douglas; Markovich, Ronald P; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Oswald, Thomas; Patterson, Leree; Redwine, David; Reichek, Ken; Schwartz, Roger; Stevens, James; Story, Bruce; Swogger, Kurt; Taha, Angela; Thomson, Kip; Weeks, Ron; Williams, Allen; Wright, Glenn	Kanuch, Bruce; Nicholas, Gloria; Ward, Susan	E-mail correspondence providing legal advice regarding patents-in-suit	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2042	1	10/21/2005	Kanuch, Bruce M	Fitzpatrick, Ken; Glenn, Michael L; Johnson, Mark S; Korfhage, Glenn; Kreinberg, Romeo; Krupp, Stephen; Nicholas, Gloria; Schwartz, Roger; Stuart, Duncan; Swogger, Kurt; Wheeler, Scot		E-mail correspondence providing legal advice regarding case in suit	AC
2043	1	05/09/2006	Johnson, Mark S.			Draft notes prepared at the request of counsel in order to obtain legal advice	WP
2044	1	03/18/2005	Johnson, Mark S	Kanuch, Bruce	Korfhage, Glenn; Krupp, Stephen; Roper, Harry J; Trybus, Steven R	E-mail correspondence providing information to counsel in order to obtain legal advice	AC
2045	14	02/03/2005	Kanuch, Bruce	Glenn, Michael; Johnson, Mark S		Presentation prepared by counsel providing legal advice	AC, WP
2046	21	12/16/2005	Kanuch, Bruce	Glenn, Michael; Johnson, Mark S		Presentation prepared by counsel providing legal advice regarding patent infringement	AC, WP
2047	1	05/11/2005	Hazlitt, Lonnie	Johnson, Mark S		E-mail correspondence regarding testing performed at the request of counsel in anticipation of litigation	WP
2048	27	09/04/2003	Hazlitt, Lonnie	Johnson, Mark S		Testing performed at the request of counsel in anticipation of litigation	WP
2049	1	05/11/2005	Hazlitt, Lonnie	Johnson, Mark S		E-mail correspondence attaching testing performed at the request of counsel in anticipation of litigation	WP
2050	27	09/04/2003	Hazlitt, Lonnie	Johnson, Mark S		Attached testing performed at the request of counsel in anticipation of litigation	WP
2051	1	08/29/2006				Removed as non-responsive and not relevant to the litigation	
2052	1	09/17/2006	Hazlitt, Lonnie	Johnson, Mark S		E-mail attaching testing performed at the request of H. Roper in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2053	1	08/06/2004	Porter, Gregory	Glenn, Michael L	Boulware, Margaret A; Johnson, Mark S; Kanuch, Bruce; Krupp, Stephen	E-mail correspondence between M. Glenn and G. Porter regarding testing performed in anticipation of litigation and reflecting attorney-client communication	AC
2054	2	03/31/2005	Johnson, Mark S; Hays, Michael	Hays, Michael; Johnson, Mark S; Wright, Glenn		E-mail correspondence regarding analysis performed at the request of H. Roper	WP
2055	2	12/06/2004	Johnson, Mark S	Kanuch, Bruce; Roper, Harry J		E-mail correspondence to B. Kanuch and H. Roper regarding work completed at the request of M. Glenn and H. Roper in anticipation of litigation in order to obtain legal advice	AC, WP
2056	12	05/06/2004		Kanuch, Bruce; Roper, Harry J		Attached patent provided to H. Roper in order to obtain legal advice	AC
2057	1	01/03/2005	Johnson, Mark S	Conboy, Claire; Crown, Alechia; Green, Shayne; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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2058	1	08/31/2003	Johnson, Mark S	Anderson, Kenneth W; Arnoudse, Peter; Bernier, Robert; Cobler, Brad; Crim, Brad; deGroot, A Willem; Dekunder, Staci; Dowling, Nicole; Eversdyk, David; Fan, Leslie; Fordyce, William; Gillespie, David; Hazlitt, Lonnie; Jain, Pradeep; Karjala, Teresa; Koch, Kaelyn; Kolthammer, Brian; Krupp, Stephen; Mcconnell, Dennis; Michie, William; Niemann, Debra; Patterson, Leree; Peters, Herbert; Ramsey, David; Sehanobish, Kalyan; Stevens, James; Story, Bruce; Vanderhider, Alan; Wooster, Jeffrey	Reichek, Ken; Turk, Thelma	E-mail correspondence discussing analysis and testing performed at the request of in-M. Glenn in anticipation of litigation	WP
2059	29	08/18/2003	Johnson, Mark S; Billings, Mike; Dekunder, Staci; Larsen, Doug; McConnell, Dennis; Niemann, Debra; Nietvelt, Paul, Patterson, Leree; Wright, Glenn			Presentation prepared at the request of M. Glenn in anticipation of litigation regarding patent infringement	WP
2060	1	08/17/2005	Johnson, Mark S	Balke, Stephen T	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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2061	4	03/04/2005	Kanuch, Bruce M; Nicholas, Gloria; Hollingshead, Beckie	Roper, Harry J; Trybus, Steven; Kanuch, Bruce M M; Nicholas, Gloria; Hollingshead, Beckie; Ward, Susan M; Martin, Travis	Glenn, Michael; Johnson, Mark S; Korfhage, Glenn; Ward, Susan M; Martin, Travis	E-mail correspondence providing legal advice regarding the patents-in-suit	AC
2062	2	02/25/2004	Docking, Darrel; Hazlitt, Andrea	Carnahan, Edmund; Jorgensen, Bob; Kolthammer, Brian; Docking, Darrel; Hazlitt, Andrea	Johnson, Mark S; Van Buren, Frederik	E-mail correspondence requesting information on behalf of Dow legal department in order to provide legal advice	AC
2063	1	10/21/2005	Johnson, Mark S; Kanuch, Bruce M	Fordyce, William; Story, Bruce; Wheeler, Scot; Fitzpatrick, Ken; Glenn, Michael L; Johnson, Mark S; Korfhage, Glenn; Kreinberg, Romeo; Krupp, Stephen; Nicholas, Gloria; Schwartz, Roger; Stuart, Duncan; Swogger, Kurt W		E-mail correspondence forwarding legal advice of B. Kanuch regarding present litigation	AC
2064	1	01/10/2005	Johnson, Mark S; Williams, Allen	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence attaching testing performed at the request of H. Roper in anticipation of litigation	WP
2065	6	01/10/2005	Williams, Allen; Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Attached testing performed at the request of H. Roper in anticipation of litigation	WP
2066	6	01/10/2005	Williams, Allen; Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Attached testing performed at the request of H. Roper in anticipation of litigation	WP
2067	6	01/10/2005	Williams, Allen; Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Attached testing performed at the request of H. Roper in anticipation of litigation	WP
2068	6	01/10/2005	Williams, Allen; Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Attached testing performed at the request of H. Roper in anticipation of litigation	WP
2069	6	01/10/2005	Williams, Allen; Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Attached testing performed at the request of H. Roper in anticipation of litigation	WP

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2070	6	01/10/2005	Williams, Allen; Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Attached testing performed at the request of H. Roper in anticipation of litigation	WP
2071	2	02/24/2005	Kanuch, Bruce M; Martinez, Selso	Roper, Harry J; Trybus, Steven; Kanuch, Bruce M	Johnson, Mark S; Krupp, Stephen	E-mail correspondence between counsel providing information regarding patents-in-suit in order to obtain legal advice	AC
2072	13	02/23/2005	Martinez, Selso	Kanuch, Bruce M; Roper, Harry J; Trybus, Steven R		Attached information regarding the patents-in-suit gathered at the request of H. Roper in anticipation of litigation and provided in order to obtain legal advice	AC, WP
2073	3	12/13/2004	Johnson, Mark S; Kanuch, Bruce M	Kanuch, Bruce; Roper, Harry	Johnson, Mark S	E-mail correspondence regarding work performed in anticipation of litigation in order to obtain legal advice	AC, WP
2074	12	05/06/2004		Kanuch, Bruce; Roper, Harry		Attached patent provided to counsel in order to obtain legal advice	AC
2075	2	08/04/2003	Johnson, Mark S	Sanchez, Ruben	Dekunder, Staci; Gibbons, Julie; Niemann, Debra	Removed and produced	
2076	2	08/07/2003	Sanchez, Ruben	Johnson, Mark S	Cassiday, Mike; Dekunder, Staci; Gibbons, Julie; Niemann, Debra	Removed and produced	
2077	2	04/14/2005	Johnson, Mark S; Kanuch, Bruce M	Krupp, Stephen; Story, Bruce; Schwartz, Roger	Glenn, Michael L; Johnson, Mark S	E-mail correspondence regarding legal advice of B. Kanuch regarding the present litigation	AC
2078	3	04/13/2005	Kanuch, Bruce M	Schwartz, Roger; Story, Bruce; Krupp, Stephen		Attached correspondence providing legal advice of B Kanuch regarding the present litigation	AC
2079	1	04/14/2005	Johnson, Mark S	Kanuch, Bruce; Story, Bruce; Krupp, Stephen	Krupp, Stephen	Ättached e-mail correspondence summarizing work performed in anticipation of litigation provided to B. Kanuch and S. Krupp in order to obtain legal advice	AC, WP
2080	2	10/21/2005	Johnson, Mark S	Fordyce, William; Krupp, Stephen; Story, Bruce; Kanuch, Bruce M		E-mail correspondence forwarding legal advice of B. Kanuch regarding the present litigation	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2081	1	10/13/2005	Trybus, Steven R	Kanuch, Bruce	Johnson, Mark S; Roper, Harry J; Nimrod, Raymond N.; Barlow, Aaron A; Marinelli, Joseph F; Kiel, Kristopher R.; Johnson, Mark S	E-mail correspondence between counsel requesting legal advice in present litigation	AC
2082	4	10/21/2005		Kanuch, Bruce M	Johnson, Mark S	Attached draft legal filing provided with request for legal advice	AC
2083	1	08/27/2004	Johnson, Mark S; Taha, Angela	Hazlitt, Lonnie; Johnson, Mark S	Taha, Angela	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2084	6	08/26/2004	Taha, Angela	Hazlitt, Lonnie; Johnson, Mark S	Taha, Angela	Testing performed at the request of G. Porter in anticipation of litigation	WP
2085	1	01/14/2005	Taha, Angela; Zhou, Zhe	Johnson, Mark S; Conboy, Claire	Conboy, Claire; Crown, Alechia; Green, Shayne; Zhou, Zhe; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2086	3	01/12/2005		Taha, Angela		Testing performed at the request of H. Roper in anticipation of litigation	WP
2087	2	12/05/2005	Kanuch, Bruce; Johnson, Mark S	Glenn, Michael L; Kanuch, Bruce M	Johnson, Mark S	E-mail correspondence providing legal advice regarding the present litigation	AC
2088	21	03/2005	Kanuch, Bruce M	Glenn, Michael L	Johnson, Mark S	Attached presentation prepared by counsel providing legal advice regarding patent infringement	AC, WP
2089	26	04/08/2005	Johnson, Mark S; Kanuch, Bruce M	Glenn, Michael L	Johnson, Mark S	Attached presentation prepared by counsel providing legal advice regarding patent infringement	AC, WP
2090	22	04/14/2005	Kanuch, Bruce M	Glenn, Michael L	Johnson, Mark S	Attached presentation prepared by counsel providing legal advice regarding patent infringement	AC, WP
2091	3	11/19/2004	Odonnell, Brian P; Kanuch, Bruce M	Kanuch, Bruce; O'Donnell, Brian P.	Johnson, Mark S; Krupp, Stephen; Roper, Harry J; Trybus, Steven R	E-mail correspondence providing legal advice regarding present patent infringement dispute	AC

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2092	56	11/19/2004	Roper, Harry J	Kanuch, Bruce	Johnson, Mark S; Krupp, Stephen; Roper, Harry J; Trybus, Steven R	Attached presentation providing legal advice regarding present patent infringement dispute prepared by counsel in anticipation of litigation	AC, WP
2093	4	11/30/2004	Odonnell, Brian P; Kanuch, Bruce M	Kanuch, Bruce; O'Donnell, Brian P.	Johnson, Mark S; Krupp, Stephen; Roper, Harry J; Trybus, Steven R	E-mail correspondence providing legal advice regarding present patent infringement dispute	AC
2094	7	10/29/2004		Kanuch, Bruce	Johnson, Mark S; Krupp, Stephen; Roper, Harry J; Trybus, Steven R	Attached sample court filing reflecting attorney-client privileged communications with Dow Legal Dept.	AC, WP
2095	8	10/13/2004		Kanuch, Bruce	Johnson, Mark S; Krupp, Stephen; Roper, Harry J; Trybus, Steven R	Attached sample court filing reflecting attorney-client privileged communications with Dow Legal Dept.	AC, WP
2096	2	05/16/2005	Kanuch, Bruce M; Martin, Travis	Johnson, Mark S; Kanuch, Bruce M M		E-mail correspondence requesting information in order to provide legal advice regarding patent infringement	AC
2097	1	05/16/2005		Johnson, Mark S		Attached slide reflecting request for information from B. Kanuch in order to provide legal advice	AC
2098	1	04/22/2003	Johnson, Mark S; Story, Bruce	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Hazlitt, Andrea; Johnson, Mark S	Bellmore, David; Cobler, Brad; Kardos, Lori; Story, Bruce; Weeks, Ron	Removed and produced	
2099	1					Removed and produced	
2100	2	02/07/2005	Hays, Michael; Johnson, Mark S	Johnson, Mark S; Hays, Michael	Wright, Glenn	E-mail correspondence regarding financial analysis performed at the request of M. Glenn in anticipation of litigation	WP
2101	4	02/07/2005	Hays, Michael	Johnson, Mark S; Hays, Michael	Wright, Glenn	Attached analysis performed at the request of counsel in anticipation of litigation	WP

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2102	3	04/14/2005	Johnson, Mark S	Kanuch, Bruce; Krupp, Stephen; Roper, Harry	Hazlitt, Lonnie; Turk, Thelma	E-mail correspondence regarding articles provided to counsel in order to obtain legal advice in anticipation of litigation	AC, WP
2103	15	04/14/2005		Kanuch, Bruce; Krupp, Stephen; Roper, Harry	Hazlitt, Lonnie; Turk, Thelma	Article provided to counsel in order to obtain legal advice	AC
2104	17	04/14/2005		Kanuch, Bruce; Krupp, Stephen; Roper, Harry	Hazlitt, Lonnie; Turk, Thelma	Article provided to counsel in order to obtain legal advice	AC
2105	12	04/14/2005		Kanuch, Bruce; Krupp, Stephen; Roper, Harry	Hazlitt, Lonnie; Turk, Thelma	Article provided to counsel in order to obtain legal advice	AC
2106	1	09/23/2003	Johnson, Mark S; Reichek, Ken	Sehanobish, Kalyan; Johnson, Mark S	Reichek, Ken	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
2107	2	05/29/2003	Johnson, Mark S; Story, Bruce; Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn; Story, Bruce; Johnson, Mark S	Bellmore, David; Cobler, Brad; Dowling, Nicole; Kardos, Lori; Koch, Kaelyn; Krupp, Stephen; PetersIII, Herbert; Presa, John; Ramsey, David; Smith, Dave; Wooster, Jeffrey	E-mail correspondence regarding work performed at the request of M. Glenn in anticipation of litigation	WP
2108	1	07/28/2005	Reichek, Ken; Gupta, Pankaj	Johnson, Mark S; Reichek, Ken		E-mail correspondence providing expert information at the request of counsel in anticipation of litigation in order to obtain legal advice	WP
2109	1	06/15/2005	Johnson, Mark S; Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2110	7	06/15/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe; Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP

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2111	1	06/15/2005	Nelson, Mike	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Reichek, Ken; Taha, Angela; Zhou, Zhe; Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
2112	1	12/20/2003	Johnson, Mark S	Glenn, Michael L	Krupp, Stephen; Story, Bruce	E-mail correspondence providing information in anticipation of litigation in order to obtain legal advice regarding patent infringement	AC, WP
2113	34	12/20/2003		Glenn, Michael L	Krupp, Stephen; Story, Bruce	Attached patent provided with legal advice	AC
2114	16	12/20/2003		Glenn, Michael L	Krupp, Stephen; Story, Bruce	Attached patent provided with legal advice	AC
2115	14	12/20/2003		Glenn, Michael L	Krupp, Stephen; Story, Bruce	Attached patent provided with legal advice	AC
2116	22	12/19/2003	Johnson, Mark S	Glenn, Michael L	Krupp, Stephen; Story, Bruce	Attached privileged presentation prepared at the request of H. Roper in anticipation of litigation	WP
2117	1	04/18/2005	Johnson, Mark S	Kanuch, Bruce		E-mail correspondence providing counsel with competitive information in anticipation of litigation in order for client to obtain legal advice	AC, WP
2118	1	04/18/2005	Hays, Michael	Johnson, Mark S; Schwartz, Roger; Kanuch, Bruce M		Removed and produced	
2119	2	04/18/2005	Pirtle, Shaun; Laehu, Joe; Hays, Michael	Hays, Michael; Laehu, Joe; Gibbons, Julie; Kardos, Lori; Pirtle, Shaun E; Cobler, Brad; Kanuch, Bruce M	Cobler, Brad; Fernandez, Tomas; Gibbons, Julie; Kardos, Lori; Roth, Christine	Removed and produced	
2120	2	04/17/2005	Nietvelt, Paul; Thomson, Kip; Hays, Michael	Hays, Michael; Thomson, Kip; Laehu, Joe; Kanuch, Bruce M	Nietvelt, Paul	Removed and produced	
2121	1	04/15/2005	Thomson, Kip; Hays, Michael	Hays, Michael; Thomson, Kip; Laehu, Joe; Kanuch, Bruce M		Removed and produced	

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2122	1	08/03/2004	Johnson, Mark S	Chum, Stephen; Lai, Shih-Yaw; Sehanobish, Kalyan; Wu, Shaofu	Hazlitt, Lonnie; Patel, Rajen	E-mail correspondence sent at the request of G. Porter and B. Kanuch requesting information in order to provide legal advice	AC
2123	2	07/18/2003	Johnson, Mark S	Anderson, Kenneth W; Bernier, Robert; Cobler, Brad; Crim, Brad; deGroot, A Willem; Dekunder, Staci; Dowling, Nicole; Eversdyk, David; Fordyce, William; Gillespie, David; Hazlitt, Lonnie; Jain, Pradeep; Karjala, Teresa; Koch, Kaelyn; Kolthammer, Brian; Krupp, Stephen; Mcconnell, Dennis; Niemann, Debra; Ramsey, David; Sehanobish, Kalyan; Story, Bruce; Wooster, Jeffrey	Turk, Thelma	Removed because duplicate of #240	
2124	1	04/11/2005	Johnson, Mark S	Hays, Michael	Glenn, Michael; Kanuch, Bruce; Schwartz, Roger	E-mail correspondence regarding slides prepared at the request of M. Glenn in anticipation of litigation regarding patent infringement	WP
2125	6	04/08/2005	Johnson, Mark S; Kanuch, Bruce M.	Hays, Michael	Glenn, Michael; Kanuch, Bruce; Schwartz, Roger	Attached slides prepared by and at the request of counsel in anticipation of litigation regarding patent infringement	AC, WP
2126	3	06/08/2004	Patel, Rajen	Johnson, Mark S		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2127	1	02/16/2004	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2128	17	10/27/2003, 02/14/2004	Johnson, Mark S	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen		Testing performed at the request of M. Glenn and G. Porter in anticipation of litigation	WP

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2129	1	03/03/2005	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2130	67	03/03/2005	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
2131	66	03/03/2005	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
2132	68	03/03/2005	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
2133	2	02/02/2005	Zhou, Zhe	Johnson, Mark S; Taha, Angela	Zhou, Zhe	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2134	1	04/14/2005	Kanuch, Bruce M	Schwartz, Roger	Glenn, Michael; Johnson, Mark S	E-mail correspondence providing legal advice regarding patent infringement	AC
2135	3	04/13/2005	Kanuch, Bruce M	Schwartz, Roger		Attached correspondence providing legal advice in anticipation of litigation regarding patent infringement	AC, WP
2136	1	04/14/2005	Johnson, Mark S	Kanuch, Bruce	Krupp, Stephen	Attached correspondence providing information gathered in anticipation of litigation in order to obtain legal advice	AC, WP
2137	1	10/05/2004	Kanuch, Bruce M	Johnson, Mark S; Krupp, Stephen	Glenn, Michael; Porter, Greg	E-mail from attorney providing attachment and containing legal advice regarding patent infringement	AC
2138	1	10/05/2004		Johnson, Mark S; Krupp, Stephen	Glenn, Michael; Porter, Greg	E-mail attachment provided by counsel to support legal advice given	AC
2139	1	08/02/2004	Kanuch, Bruce M	Johnson, Mark S		E-mail requesting information in order to provide legal advice and reflecting attorney-client communications with B. Kanuch, Esq.	AC
2140	1	06/08/2005	Kanuch, Bruce M	Schwartz, Roger	Johnson, Mark S; Roper, Harry J	E-mail correspondence providing legal advice regarding present litigation	AC
2141	1	05/25/2005	Fordyce, William	Glenn, Michael L	Johnson, Mark S; Schwartz, Roger; Story, Bruce; Swogger, Kurt	E-mail correspondence providing information to counsel in order to obtain legal advice	AC
2142	1	02/25/2005	Kanuch, Bruce M	Johnson, Mark S; ; Krupp, Stephen; Mark; Roper, Harry J; Trybus, Steven		E-mail correspondence providing legal advice regarding patent infringement	AC, WP

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2143	1	06/10/2004	Johnson, Mark S	Wright, Glenn		E-mail correspondence regarding presentation prepared at the request of counsel in anticipation of litigation	WP
2144	24	06/10/2004	Johnson, Mark S			Presentation prepared at the request of counsel in anticipation of litigation	WP
2145	5	06/22/2004	Johnson, Mark S	Fordyce, William; Glenn, Michael L; Kanuch, Bruce; Krupp, Stephen; Schwartz, Roger; Story, Bruce; Wright, Glenn	Porter, Greg	E-mail correspondence providing article to counsel in order to obtain legal advice	AC
2146	1	08/02/2004	Porter, Gregory	Johnson, Mark S		E-mail correspondence providing data collected at the request of an attorney in anticipation of litigation	WP
2147	21	07/01/2004				Data collected at the request of an attorney in anticipation of litigation	WP
2148	1	08/02/2004	Porter, Gregory	Johnson, Mark S		E-mail from attorney with attached work product prepared in anticipation of litigation	WP
2149	2	07/22/2004				Data collected at the request of an attorney in anticipation of litigation	WP
2150	1	04/19/2005	Johnson, Mark S	Schwartz, Roger	Glenn, Michael; Hays, Michael; Kanuch, Bruce; Krupp, Stephen; Mcalindon, Julie; Story, Bruce	E-mail correspondence providing information at the request of the Dow legal department in order to provide legal advice regarding patent infringement in anticipation of litigation	AC, WP
2151	2	04/18/2005	Johnson, Mark S	Schwartz, Roger	Glenn, Michael; Hays, Michael; Kanuch, Bruce; Krupp, Stephen; Mcalindon, Julie; Story, Bruce	Attached notes providing information prepared in anticipation of litigation in order to provide legal advice	AC, WP
2152	37	03/21/2003				Removed and produced	

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2153	29	11/30/1999	Van Dun J; Weeks, Ron; Wu, S	Schwartz, Roger	Glenn, Michael; Hays, Michael; Kanuch, Bruce; Krupp, Stephen; Mcalindon, Julie; Story, Bruce	Attached R&D report provided at the request of counsel in order to provide legal advice	AC
2154	1	02/16/2004	Johnson, Mark S	Glenn, Michael L; Kanuch, Bruce; Krupp, Stephen; Porter, Greg; Story, Bruce	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen	E-mail correspondence providing presentation prepared in anticipation of litigation to counsel in order to obtain legal advice	AC, WP
2155	6	02/13/2004	Johnson, Mark S	Glenn, Michael L; Kanuch, Bruce; Krupp, Stephen; Porter, Greg; Story, Bruce	Hazlitt, Lonnie; Reichek, Ken; Williams, Allen	Attached presentation prepared at the request of counsel in anticipation of litigation provided to counsel in order to obtain legal advice	AC, WP
2156	1	12/20/2004	Krupp, Stephen	Kanuch, Bruce; Nicholas, Gloria	Johnson, Mark S	E-mail correspondence providing legal advice regarding a patent-in-suit	AC
2157	2	08/05/2005	Johnson, Mark S; Gibbons, Julie	Anderson, Kenneth W; Cobler, Brad; Cotton, Robert; Eckel, Jason; Hazlitt, Lonnie; Heard, Mark; Larsen Jr, Douglas; Mcconnell, Dennis; Nietvelt, Paul; Reichek, Ken; Johnson, Mark S	Collick, Scott; Fordyce, William; Gibbons, Julie; Kanuch, Bruce; Krupp, Stephen; Marinelli, Joseph F; Mcalindon, Julie; Niemann, Debra; Roper, Harry J; Schwartz, Roger; Story, Bruce; Trybus, Steven; Niemann, Debra; Fernandez, Tomas	E-mail correspondence providing information to counsel in anticipation of litigation in order to obtain legal services	AC, WP
2158	1	08/05/2005				Removed and produced	

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2159	1	12/01/2004	Johnson, Mark S	Anderson, Kenneth W; Chum, Stephen; Hazlitt, Lonnie; Jain, Pradeep; Kolthammer, Brian; Krupp, Stephen; Lai, Shih-Yaw; Markovich, Ronald P; Mcconnell, Dennis; Niemann, Debra; Oswald, Thomas; Weeks, Ron		E-mail correspondence at the request of Dow's legal department requesting information in order to provide advice regarding patent infringement	AC
2160	12	05/06/2004		Anderson, Kenneth W; Chum, Stephen; Hazlitt, Lonnie; Jain, Pradeep; Kolthammer, Brian; Krupp, Stephen; Lai, Shih-Yaw; Markovich, Ronald P; Mcconnell, Dennis; Niemann, Debra; Oswald, Thomas; Weeks, Ron		Patent provided at the request of counsel in order to request information to provide legal advice	AC
2161	1	10/20/2004	Johnson, Mark S	Roper, Harry	Glenn, Michael; Kanuch, Bruce; Krupp, Stephen; Story, Bruce	E-mail correspondence providing information to counsel in order to obtain legal advice	AC
2162	1	06/01/2005	Johnson, Mark S	Barlow, Aaron A; Kanuch, Bruce; Roper, Harry; Trybus, Steven	Balke, Stephen T; Hazlitt, Lonnie; Krupp, Stephen	E-mail correspondence providing information to counsel in order to obtain legal advice	AC
2163	9	08/21/2001		Barlow, Aaron A; Kanuch, Bruce; Roper, Harry; Trybus, Steven	Balke, Stephen T; Hazlitt, Lonnie; Krupp, Stephen	Attached patent provided to counsel in order to obtain legal advice	AC
2164	1	02/11/2005	Johnson, Mark S; Fordyce, William	Silva, Maria Clara; Wu, T J; Johnson, Mark S	Fordyce, William	E-mail correspondence forwarding work product prepared at the request of counsel in anticipation of litigation	WP
2165	24	10/23/2003	Johnson, Mark S			Attached presentation prepared at the request of M. Glenn in anticipation of litigation	WP
2166	42	04/15/2004	Johnson, Mark S			Attached presentation prepared at the request of M. Glenn in anticipation of litigation	WP

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2167	18	04/30/2004	Johnson, Mark S			Attached presentation prepared at the request of M. Glenn in anticipation of litigation	WP
2168	19	04/30/2004	Johnson, Mark S			Attached presentation prepared at the request of M. Glenn in anticipation of litigation	WP
2169	10	07/26/2004	Johnson, Mark S			Attached presentation prepared at the request of M. Glenn in anticipation of litigation	WP
2170	1	03/14/2005	Coker, Wayne	Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2171	1	01/14/2005	Jones, Laura	Yusuf, Siaka	Johnson, Mark S	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2172	5	01/14/2005	Jones, Laura			Testing performed at the request of H. Roper in anticipation of litigation	WP
2173	1	02/11/2005	Johnson, Mark S	Story, Bruce		E-mail correspondence regarding financial information prepared at the request of M. Glenn in anticipation of litigation	WP
2174	2	04/17/2005	Johnson, Mark S; Gibbons, Julie	Glenn, Michael L; Kanuch, Bruce; Roper, Harry J; Trybus, Steven; Cotton, Robert; Thomson, Kip; Johnson, Mark S; Krupp, Stephen; Mergenhagen, Laura; Laehu, Joe; Niemann, Debra	Hays, Michael; Krupp, Stephen; Mcalindon, Julie; Schwartz, Roger; Story, Bruce; Wooster, Jeffrey J; Fernandez, Tomas	E-mail correspondence providing technical information to M. Glenn and Jenner & Block attorney team in order to obtain legal advice in anticipation of litigation	AC, WP
2175	1	02/07/2005	Johnson, Mark S	Wright, Glenn		E-mail correspondence regarding presentation prepared at the request of counsel in anticipation of litigation	WP
2176	1	02/04/2005	Johnson, Mark S			Notes for presentation prepared at the request of counsel in anticipation of litigation	WP

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2177	1	10/02/2003	Johnson, Mark S	Beil, Robert; Fordyce, William; Glenn, Michael L; Kreinberg, Romeo; Schwartz, Roger; Sexton, Diane; Story, Bruce; Swogger, Kurt; Vanderhider, Alan	Anderson, Kenneth W; Bernier, Robert; Billings, Mike; deGroot, A Willem; Dekunder, Staci; Gillespie, David; Hazlitt, Lonnie; Koch, Kaelyn; Kolthammer, Brian; Krupp, Stephen; Larsen, Douglas; Mcconnell, Dennis; Michie, William; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Reichek, Ken; Sehanobish, Kalyan; Wright, Glenn	E-mail correspondence regarding testing performed at the request of counsel in anticipation of litigation	AC, WP
2178	1	02/07/2005	Johnson, Mark S	Hays, Michael	Wright, Glenn	E-mail correspondence attaching financial data regarding patent enforcement strategy generated at the request of counsel in anticipation of litigation	WP
2179	4	02/07/2005	Johnson, Mark S			Attached spreadsheet containing financial data regarding patent enforcement strategy generated at request of counsel in anticipation of litigation.	WP
2180	1	02/03/2005	Johnson, Mark S	Chum, Stephen	Krupp, Stephen	E-mail correspondence reflecting attorney-client communications with Dow legal department and requesting information in order to provide legal advice regarding patent infringement	AC, WP
2181	1	05/27/2005	Zhou, Zhe	Green, Shayne; Johnson, Mark S		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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2182	1	05/26/2005	Zhou, Zhe	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2183	1	07/20/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2184	8	07/20/2005	Zhou, Zhe	Coker, Wayne; Conboy, Claire; Green, Shayne; Hazlitt, Lonnie; Johnson, Mark S; Taha, Angela		Report regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2185	1	08/31/2003	Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn		E-mail correspondence regarding presentation prepared at the request of counsel in anticipation of litigation	WP
2186	29	08/18/2003	Johnson, Mark S.; Dekunder, Staci; Larsen, Doug; McConnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn			Presentation prepared at the request of M. Glenn in anticipation of litigation	WP
2187	2	04/29/2005	Zhou, Zhe; Johnson, Mark S	Conboy, Claire; Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2188	2	04/29/2005	Green, Shayne; Johnson, Mark S; Zhou, Zhe	Conboy, Claire; Johnson, Mark S; Taha, Angela; Zhou, Zhe; Green, Shayne	Coker, Wayne; Crown, Alechia; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2189	1	01/28/2005	Conboy, Claire; Zhou, Zhe	Crown, Alechia; Green, Shayne; Johnson, Mark S; Taha, Angela; Zhou, Zhe; Conboy, Claire	Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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2190	5	07/27/2005	Trybus, Steven R; Johnson, Mark S; Kanuch, Bruce M	Johnson, Mark S; Kanuch, Bruce; Marinelli, Joseph F; Trybus, Steven	Krupp, Stephen; Roper, Harry J; Kanuch, Bruce M	E-mail correspondence between B. Kanuch and S. Krupp and H. Roper regarding experts providing legal advice in the present litigation	AC
2191	1	05/31/2005	Kanuch, Bruce M; Johnson, Mark S	Johnson, Mark S; Kanuch, Bruce M M		E-mail correspondence providing advice of counsel regarding patent infringement	AC
2192	1	02/17/2004	Gillespie, David; Johnson, Mark S	Johnson, Mark S; Gillespie, David	Reichek, Ken	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2193	2	06/21/2005	Green, Shayne; Johnson, Mark S; Coker, Wayne	Johnson, Mark S; Green, Shayne; Coker, Wayne; Reichek, Ken; Nelson, Mike	Zhou, Zhe; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela; Green, Shayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2194	1	03/31/2005	Johnson, Mark S; Trybus, Steven R	Kanuch, Bruce; Trybus, Steven R; Johnson, Mark S	Krupp, Stephen; Marinelli, Joseph F; Roper, Harry J	E-mail correspondence providing information to Jenner & Block attorneys in order to obtain legal advice	AC

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2195	3	01/05/2005	Nicholas, Gloria	Anderson, Kenneth W; Cardwell, Scott; Chum, Stephen; Coker, Wayne; Dekunder, Staci; Fordyce, William; Hazlitt, Lonnie; Johnson, Mark S; Kolthammer, Brian; Krupp, Stephen; Lai, Shih-Yaw; Larsen Jr, Douglas; Markovich, Ronald P; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Oswald, Thomas; Patterson, Leree; Redwine, David; Reichek, Ken; Schwartz, Roger; Stevens, James; Story, Bruce; Swogger, Kurt; Taha, Angela; Thomson, Kip; Weeks, Ron; Williams, Allen; Wright, Glenn	Kanuch, Bruce; Korfhage, Glenn; Ward, Susan; Ward, Susan M; Nicholas, Gloria	E-mail correspondence providing legal advice of B. Kanuch regarding present litigation	AC
2196	3	02/25/2005	Trybus, Steven R; Roper, Harry J; Krupp, Stephen; Johnson, Mark S; Martinez, Selso	Johnson, Mark S; Kanuch, Bruce; Krupp, Stephen; Roper, Harry J; Trybus, Steven	Krupp, Stephen; Johnson, Mark S	E-mail correspondence providing legal advice regarding the patents-in-suit	AC
2197	1	03/01/2005	Trybus, Steven R; Johnson, Mark S	Johnson, Mark S; Trybus, Steven	Kanuch, Bruce; Krupp, Stephen; Roper, Harry J	E-mail correspondence providing legal advice regarding expert	AC
2198	1	08/04/2005	Trybus, Steven R; Johnson, Mark S	Johnson, Mark S; Marinelli, Joseph F; Roper, Harry J; Trybus, Steven	Kanuch, Bruce; Kiel, Kristopher R	E-mail correspondence providing legal advice regarding expert	AC
2199	1	02/25/2005	Hays, Michael; Johnson, Mark S	Johnson, Mark S; Hays, Michael	Wright, Glenn	E-mail correspondence attaching financial product comparison report prepared at the request of counsel in anticipation of litigation	WP

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2200	5	02/25/2005	Hays, Michael	Johnson, Mark S; Hays, Michael		Attached report regarding financial product comparison prepared at the request of counsel in anticipation of litigation	WP
2201	3	04/04/2005	Hays, Michael; Johnson, Mark S	Johnson, Mark S; Hays, Michael		E-mail correspondence regarding product sales and prepared at the request of counsel in anticipation of litigation	WP
2202	2	02/25/2005	Johnson, Mark S; Hays, Michael	Hays, Michael; Johnson, Mark S	Wright, Glenn	E-mail correspondence regarding marketing assessments prepared at the request of counsel in anticipation of litigation	WP
2203	1	09/02/2003	Story, Bruce; Johnson, Mark S	Johnson, Mark S; Dekunder, Staci; Fordyce, William; Niemann, Debra; Ramsey, David; Hazlitt, Lonnie; McConnell, Dennis; Krupp, Stephen; Story, Bruce; Kolthammer, Brian W.S; Anderson, Kenneth W; Crim, Brad; Sehanobish, Kalyan; Cobler, Brad; Dowling, Nicole; Koch, Kaeyln; Wooster, Jeffrey J; Degroot, Willem; Gillespie, David; Karjala, Teresa; Bernier, Robert; Eversdyk, David; Jain, Pradeep; Peters, Herbert; Patterson, Leree; Vanderhider, Alan; Stevens, James; Michie, William; Arnoudse, Peter; Fan, Leslie	Reichek, Ken; Turk, Thelma	E-mail correspondence regarding assessments performed at the request of S. Krupp in order to provide legal advice in anticipation of litigation	AC, WP

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2204	1	09/02/2003	Vanderhider, Alan; Johnson, Mark S	Johnson, Mark S; Dekunder, Staci; Fordyce, William; Niemann, Debra; Ramsey, David; Hazlitt, Lonnie; McConnell, Dennis; Krupp, Stephen; Story, Bruce; Kolthammer, Brian W.S; Anderson, Kenneth W; Crim, Brad; Sehanobish, Kalyan; Cobler, Brad; Dowling, Nicole; Koch, Kaeyln; Wooster, Jeffrey J; Degroot, Willem; Gillespie, David; Karjala, Teresa; Bernier, Robert; Eversdyk, David; Jain, Pradeep; Peters, Herbert; Patterson, Leree; Vanderhider, Alan; Stevens, James; Michie, William; Arnoudse, Peter; Fan, Leslie	Reichek, Ken; Turk, Thelma	E-mail correspondence regarding assessments performed at the request of S. Krupp in order to provide legal advice in anticipation of litigation	AC, WP
2205	4	07/21/2005	Kanuch, Bruce M; Johnson, Mark S; Schwartz, Roger	Johnson, Mark S; Kanuch, Bruce M M; Schwartz, Roger; Stuart, Duncan; Glenn, Michael L	Stuart, Duncan; Glenn, Michael; Roper, Harry J; Johnson, Mark S	E-mail correspondence providing legal advice regarding the present litigation	AC, WP
2206	1	07/08/2005	Kanuch, Bruce M	Johnson, Mark S		Attached notes providing legal advice regarding the present litigation	AC, WP
2207	2	06/20/2005	Kanuch, Bruce M	Johnson, Mark S		Attached memorandum providing legal advice regarding the present litigation	AC, WP
2208	3	07/15/2005	Kanuch, Bruce M; Schwartz, Roger	Schwartz, Roger; Kanuch, Bruce M M; Stuart, Duncan; Glenn, Michael L	Glenn, Michael; Johnson, Mark S; Roper, Harry J; Stuart, Duncan	E-mail correspondence providing legal advice regarding the present litigation	AC, WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2209	3	10/14/2005	Johnson, Mark S; Kanuch, Bruce M; Balke, Stephen T	Kanuch, Bruce; Johnson, Mark S	Roper, Harry J; Trybus, Steven; Johnson, Mark S	E-mail correspondence provided to M. Glenn and Jenner & Block attorney team regarding work performed at the request of H. Roper in order to obtain legal advice in anticipation of litigation	AC, WP
2210	2	12/23/2003	Johnson, Mark S; Glenn, Michael L	Glenn, Michael L; Johnson, Mark S	Hoppe, James; Krupp, Stephen; Story, Bruce	E-mail correspondence reflecting attorney-client communications with M Glenn, Esq. and attaching attorney-client communication reflecting legal opinions of S Krupp, Esq. and J Hoppe, Esq.	AC
2211	1	12/19/2003	Krupp, Stephen	Johnson, Mark S; Glenn, Michael L	Hoppe, James; Krupp, Stephen; Story, Bruce	Attachment to e-mail providing legal analysis of counsel	AC
2212	1	02/19/2004	Glenn, Michael L; Raab, Jane	Raab, Jane; Glenn, Michael L	Johnson, Mark S; Krupp, Stephen; Story, Bruce	E-mail correspondence regarding work performed at the request of G. Porter in anticipation of litigation	WP
2213	1	08/04/2004	Wu, Shaofu; Johnson, Mark S	Chum, Stephen; Johnson, Mark S; Lai, Shih-Yaw; Sehanobish, Kalyan; Wu, Shaofu	Hazlitt, Lonnie; Patel, Rajen	E-mail correspondence regarding expert strategy in anticipation of litigation	WP
2214	1	01/13/2004	Johnson, Mark S; Story, Bruce	Krupp, Stephen; Story, Bruce; Johnson, Mark S	Hocutt, Pamela; Glenn, Michael	E-mail correspondence regarding meeting scheduled in order to obtain legal advice	AC, WP
2215	2	01/19/2004		Krupp, Stephen; Story, Bruce; Johnson, Mark S	Hocutt, Pamela; Glenn, Michael	Attached meeting agenda to obtain legal advice	AC, WP
2216	2	09/24/2003	Marroquin, Deborah; Johnson, Mark S; Reichek, Ken	Johnson, Mark S; Marroquin, Deborah; Sehanobish, Kalyan	Patel, Rajen; Reichek, Ken	E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
2217	1	11/14/2003	Hazlitt, Lonnie; Johnson, Mark S	Johnson, Mark S; Hazlitt, Lonnie		E-mail correspondence regarding testing performed at the request of M. Glenn in anticipation of litigation	WP
2218	2	06/10/2005	Zhou, Zhe; Johnson, Mark S	Conboy, Claire; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken; Coker, Wayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2219	3	06/15/2005	Hazlitt, Lonnie; Conboy, Claire; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Conboy, Claire; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Hazlitt, Lonnie; Reichek, Ken; Coker, Wayne	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP

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2220	3	07/22/2005	Johnson, Mark S; Marinelli, Joseph F	Marinelli, Joseph F; Johnson, Mark S	Hazlitt, Lonnie; Kanuch, Bruce; Krupp, Stephen; Reichek, Ken; Roper, Harry J; Trybus, Steven R	E-mail correspondence providing information to Jenner & Block attorney team in order to obtain legal advice regarding patent infringement	AC
2221	3	04/18/2005	Kanuch, Bruce M; Hoppe, James; Gold, Solomon M	Roper, Harry J; Kanuch, Bruce M M; Krupp, Stephen	Johnson, Mark S	E-mail correspondence providing legal advice regarding the patents-in-suit	AC
2222	2	10/18/2005	Johnson, Mark S; Story, Bruce; Kanuch, Bruce M	Krupp, Stephen; Story, Bruce; Johnson, Mark S; Roper, Harry J; Smith, Rodger; Trybus, Steven	Johnson, Mark S	E-mail correspondence providing legal advice regarding the present litigation	AC, WP
2223	2	10/14/2005	Smith, Rodger D; Trybus, Steven R	Kanuch, Bruce; Trybus, Steven R	Johnson, Mark S; Roper, Harry J; Nimrod, Raymond N; Barlow, Aaron A; Marinelli, Joseph F; Kiel, Kristopher R; Johnson, Mark S	E-mail correspondence providing legal advice regarding the present litigation	AC, WP
2224	2	07/07/2005	Trybus, Steven R; Johnson, Mark S; Kanuch, Bruce M; Marinelli, Joseph F	Johnson, Mark S; Kanuch, Bruce; Marinelli, Joseph F; Roper, Harry J	Trybus, Steven	E-mail correspondence providing legal advice regarding the present litigation	AC, WP
2225	2	07/07/2005	Kanuch, Bruce M; Johnson, Mark S; Marinelli, Joseph F	Johnson, Mark S; Marinelli, Joseph F; Kanuch, Bruce M M	Trybus, Steven	E-mail correspondence providing legal advice regarding the present litigation	AC
2226	1	06/04/2005	Schwartz, Roger; Fordyce, William	Fordyce, William; Glenn, Michael L	Johnson, Mark S; Story, Bruce; Swogger, Kurt	E-mail correspondence responding to legal advice and requesting additional legal advice regarding the present litigation	AC
2227	1	04/19/2005	Johnson, Mark S; Kanuch, Bruce M	Kanuch, Bruce; Hays, Michael	Johnson, Mark S	E-mail correspondence with counsel providing information in order to obtain legal advice regarding present litigation	AC
2228	2	04/11/2005	Johnson, Mark S; Kanuch, Bruce M	Kanuch, Bruce; Krupp, Stephen	Roper, Harry J; Johnson, Mark S	E-mail to attorneys requesting legal advice and providing information in order to obtain legal advice	AC
2229	11	01/26/2005				Removed and produced	

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2230	2	04/01/2005	Johnson, Mark S; Kanuch, Bruce M	Kanuch, Bruce; Roper, Harry J; Johnson, Mark S		E-mail to attorneys seeking legal advice and providing information created at the request of counsel in anticipation of litigation	AC, WP
2231	1	03/24/2005	Johnson, Mark S; Trybus, Steven R	Trybus, Steven R; Johnson, Mark S	Kanuch, Bruce; Marinelli, Joseph F; Roper, Harry J	E-mail to attorneys seeking legal advice and providing information requested by counsel	AC
2232	2	02/11/2005	Johnson, Mark S; Story, Bruce; Fordyce, William	Fordyce, William; Glenn, Michael L; Story, Bruce; Johnson, Mark S; Korfhage, Glenn	Korfhage, Glenn; Johnson, Mark S; Story, Bruce	E-mail correspondence seeking legal advice and reflecting attorney-client communications regarding patent enforcement strategy in anticipation of litigation.	AC, WP
2233	4	02/07/2005	Johnson, Mark S	Fordyce, William; Glenn, Michael L; Story, Bruce; Johnson, Mark S	Korfhage, Glenn; Johnson, Mark S; Story, Bruce	Attached spreadsheet containing financial data regarding patent enforcement strategy generated at request of counsel in anticipation of litigation.	WP
2234	1	02/04/2005	Johnson, Mark S			Report regarding patent enforcement strategy created in anticipation of litigation and attached to privileged E-mail communication with attorneys	WP
2235	2	09/05/2003	Fordyce, William; Johnson, Mark S	Johnson, Mark S; Fordyce, William		E-mail correspondence regarding presentation prepared at the request of in-M. Glenn in anticipation of litigation	WP
2236	2	03/02/2005	Kanuch, Bruce M	Johnson; Kanuch, Bruce M; Krupp, Stephen; Mark; Roper, Harry J; Trybus, Steven		E-mail from attorney containing legal advice and analysis in anticipation of litigation	AC, WP
2237	5	09/06/2005	Kanuch, Bruce M; Johnson, Mark S; Schwartz, Roger; Nichols, Jamie; Daly, Patricia; Johnston, Arlene	Johnson, Mark S; Kanuch, Bruce M M; Roper, Harry J; Trybus, Steven; Glenn, Michael L; Schwartz, Roger; Nichols, Jamie; Daly, Patricia; Johnston, Arlene; johnsona@novachemcom	Johnson, Mark S; Smith, Rodger	E-mail correspondence providing legal advice regarding present litigation	AC

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2238	2	04/25/2005	Schwartz, Roger; Johnson, Mark S	Johnson, Mark S; Schwartz, Roger	Kanuch, Bruce; Glenn, Michael; Hays, Michael; McAlindon, Julie; Krupp, Stephen; Story, Bruce	E-mail to attorneys requesting legal advice and containing discussion of work performed at the request of counsel in anticipation of litigation	AC, WP
2239	2	03/08/2005	Kanuch, Bruce M; Johnson, Mark S	Johnson, Mark S; Kanuch, Bruce M M	Roper, Harry J	E-mail from attorney providing legal advice and containing information regarding work performed at the request of counsel in anticipation of litigation	AC, WP
2240	2	03/10/2005	Johnson, Mark S; Kanuch, Bruce M	Kanuch, Bruce; Johnson, Mark S		E-mail to attorney requesting legal advice regarding work performed at the request of counsel in anticipation of litigation	AC, WP
2241	2	08/18/2004	Redwine, David; Johnson, Mark S	Johnson, Mark S; Taha, Angela;; Redwine, David	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mails concerning testing performed at the request of G. Porter in anticipation of litigation	WP
2242	2	08/18/2004	Taha, Angela; Johnson, Mark S	Johnson, Mark S; Redwine, David; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2243	4	08/18/2004	Taha, Angela	Johnson, Mark S; Redwine, David; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	Testing performed at the request of G. Porter in anticipation of litigation	WP
2244	1	08/18/2004	Johnson, Mark S; Taha, Angela	Redwine, David; Taha, Angela; Johnson, Mark S	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mails concerning testing performed at the request of G. Porter in anticipation of litigation	WP
2245	2	01/14/2005	Crown, Alechia; Taha, Angela; Zhou, Zhe	Johnson, Mark S; Taha, Angela; Conboy, Claire	Conboy, Claire; Green, Shayne; Zhou, Zhe; Taha, Angela; Crown, Alechia	E-mails relating to testing performed at the request of H. Roper in anticipation of litigation	WP
2246	2	08/18/2004	Taha, Angela; Johnson, Mark S	Johnson, Mark S; Redwine, David; Taha, Angela	Coker, Wayne; Hazlitt, Lonnie; Williams, Allen	E-mails concerning testing performed at the request of G. Porter in anticipation of litigation	WP

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2247	1	12/06/2004	Chum, Stephen; Johnson, Mark S	Johnson, Mark S; Hazlitt, Lonnie; Krupp, Stephen; Oswald, Thomas; Anderson, Kenneth W; Weeks, Ron; Niemann, Debra; McConnell, Dennis; Kolthammer, Brian WS; Lai, Shih-Yaw; Markovich, Ronald P; Chum, Stephen; Jain, Pradeep		E-mail correspondence requesting legal advice as well as information provided in order to obtain legal advice	AC
2248	1	12/08/2004	Kolthammer, Brian; Johnson, Mark S	Johnson, Mark S; Hazlitt, Lonnie; Krupp, Stephen; Oswald, Thomas; Anderson, Kenneth W; Weeks, Ron; Niemann, Debra; McConnell, Dennis; Kolthammer, Brian WS; Lai, Shih-Yaw; Markovich, Ronald P; Chum, Stephen; Jain, Pradeep	Krupp, Stephen	E-mail to attorney providing information in anticipation of litigation in order to obtain legal advice	AC, WP
2249	1	09/04/2003	Fordyce, William; Johnson, Mark S	Johnson, Mark S; Story, Bruce; Fordyce, William		E-mails contain information reflecting communications with M. Glenn	AC
2250	2	06/05/2005	Kanuch, Bruce M; Johnson, Mark S	Barlow, Aaron A; Johnson, Mark S; Roper, Harry; Trybus, Steven; Kanuch, Bruce M M	Balke, Stephen T; Hazlitt, Lonnie; Krupp, Stephen	E-mail from attorney providing legal advice	AC
2251	2	11/17/2004	Odonnell, Brian P; Kanuch, Bruce M	Kanuch, Bruce; O'Donnell, Brian P	Johnson, Mark S; Krupp, Stephen; Roper, Harry J	E-mail correspondence between outside counsel and Dow attorneys attaching reports and providing legal advice in anticipation of litigation	AC, WP
2252	1	11/17/2004	Odonnell, Brian P	Kanuch, Bruce; O'Donnell, Brian P	Johnson, Mark S; Krupp, Stephen; Roper, Harry J	Timeline prepared by outside counsel and provided to Dow attorneys in anticipation of litigation	AC, WP
2253	50	11/17/2004	Roper, Harry J; O'Donnell, Brian P;	Kanuch, Bruce; O'Donnell, Brian P	Johnson, Mark S; Krupp, Stephen; Roper, Harry J	Presentation created by outside counsel providing legal advice in anticipation of litigation	AC, WP

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2254	1	08/19/2003	Johnson, Mark S; Fordyce, William	Fordyce, William; Johnson, Mark S		Redaction: E-mail contains information reflecting legal advice from S. Krupp (Removed and produced)	AC
2255	1	03/21/2005	Mcalindon, Julie; Johnson, Mark S	Johnson, Mark S; McAlindon, Julie	Wright, Glenn	E-mail discussing agenda for meeting regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2256	1	08/27/2003	Johnson, Mark S; Stevens, James	Stevens, James; Johnson, Mark S		E-mail regarding testing requested by attorneys in anticipation of litigation	WP
2257	1	08/27/2003	Johnson, Mark S	Stevens, James; Johnson, Mark S		Document attached to e-mail concerning testing requested by attorneys in anticipation of litigation	WP
2258	2	09/24/1998	Story, Bruce	Chrisman, Ray	Gambrell, Ed; Johnson, Mark S; Stevens, James; Swogger, Kurt	Redaction: Statement reflecting attorney-client communications with S. Krupp regarding patent enforcement (Removed and produced)	AC
2259	2	05/16/2005	Johnson, Mark S	Kanuch, Bruce		E-mail to attorneys seeking legal advice and providing information in order to obtain legal advice	AC
2260	2	04/04/2005	Johnson, Mark S	Kanuch, Bruce; Roper, Harry J	Krupp, Stephen	E-mail to attorneys seeking legal advice and providing information in order to obtain legal advice	AC
2261	1	09/05/2003	Stevens, James	Johnson, Mark S		E-mails concerning testing performed at request of M. Glenn in anticipation of litigation	WP
2262	1	12/21/2004	Pinkerton, Jack	Johnson, Mark S		E-mail correspondence regarding product testing requested by H. Roper in anticipation of litigation	WP
2263	4	04/14/2005	Krupp, Stephen	Johnson, Mark S; Kanuch, Bruce; Roper, Harry J		E-mail from counsel containing legal advice	AC
2264	2	10/08/2004	Kanuch, Bruce M	Johnson, Mark S		E-mail from counsel containing legal advice	AC
2265	1	02/08/2005	Wright, Glenn	Johnson, Mark S		E-mail correspondence regarding information requested by counsel in anticipation of litigation	WP

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2266	3	01/26/2005	Crown, Alechia	Conboy, Claire; Johnson, Mark S; Taha, Angela; Zhou, Zhe	Green, Shayne	E-mail correspondence regarding testing performed at request of H. Roper in anticipation of litigation	WP
2267	5	12/23/2003	Johnson, Mark S	Minicucci, Carmela		Removed and produced	
2268	2	04/06/2005	Johnson, Mark S; Fordyce, William	Fordyce, William; Johnson, Mark S; Story, Bruce; Glenn, Michael L; Korfhage, Glenn	Krupp, Stephen; Kanuch, Bruce M; Turk, Thelma	E-mail correspondence regarding preparation of presentation at the request of B. Kanuch in order to provide legal advice	AC
2269	2	04/28/2004	Glenn, Michael L; Porter, Greg	Johnson, Mark S; Porter, Gregory; Glenn, Michael L		E-mail between attorneys containing legal advice regarding patent infringement	AC
2270	1	02/12/2004	Patel, Rajen; Chum, Stephen; Johnson, Mark S	Chum, Stephen; Johnson, Mark S; Lai, Shih-Yaw; ; Markovich, Ronald P; Sehanobish, Kalyan; Johnson, Mark		E-mail correspondence containing information collected at the request of G. Porter in anticipation of litigation	WP
2271	4	09/26/2003	Turk, Thelma	Patel, Rajen	Johnson, Mark S; Krupp, Stephen; Lai, Shih-Yaw	E-mail correspondence regarding information gathered at the request of Dow's legal department in anticipation of litigation and providing information in order to obtain legal advice	AC, WP
2272	25	03/27/1992	Knight, George W	Patel, Rajen	Johnson, Mark S; Krupp, Stephen; Lai, Shih-Yaw	Document attached to e-mail provided in order to obtain legal advice	AC
2273	9	03/27/1992	Lai, Shih-Yaw; Knight, George W; Chum, Stephen	Patel, Rajen	Johnson, Mark S; Krupp, Stephen; Lai, Shih-Yaw	Document attached to e-mail provided in order to obtain legal advice	AC
2274	4	09/26/2003	Turk, Thelma	Patel, Rajen	Johnson, Mark S; Krupp, Stephen; Lai, Shih-Yaw	E-mail correspondence regarding requested information by Dow's legal department gathered in anticipation of litigation in order to provide legal advice	AC, WP
2275	11	03/27/1992	Knight, George W	Patel, Rajen	Johnson, Mark S; Krupp, Stephen; Lai, Shih-Yaw	Document attached to an e-mail sent to attorney seeking legal advice	AC
2276	13	12/10/1991	Knight, George W	Patel, Rajen	Johnson, Mark S; Krupp, Stephen; Lai, Shih-Yaw	Document attached to an e-mail sent to attorney seeking legal advice	AC

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2277	4	10/10/2003	Johnson, Mark S	Lai, Shih-Yaw		E-mail correspondence regarding information gathered at the request of Dow's legal department in anticipation of litigation and reflecting attorney-client communications with S. Krupp	AC, WP
2278	4	10/09/2003	Lai, Shih-Yaw	Patel, Rajen; Turk, Thelma	Johnson, Mark S; Krupp, Stephen	E-mail correspondence regarding information gathered at the request of Dow's legal department in anticipation of litigation and reflecting attorney-client communications with S. Krupp	AC, WP
2279	3	09/26/2003	Turk, Thelma	Johnson, Mark S; Lai, Shih-Yaw	Krupp, Stephen; Patel, Rajen	E-mail correspondence regarding information gathered at the request of Dow's legal department in anticipation of litigation and reflecting attorney-client communications with S. Krupp	AC, WP
2280	3	09/26/2003	Turk, Thelma	Johnson, Mark S; Lai, Shih-Yaw	Krupp, Stephen; Patel, Rajen	Timeline prepared at the request of Dow's legal department in anticipation of litigation and attached to e-mail correspondence reflecting attorney-client communications with S. Krupp	AC, WP
2281	3	09/26/2003	Johnson, Mark S	Lai, Shih-Yaw; Turk, Thelma	Bensason, Selim; Chum, Stephen; Krupp, Stephen; Markovich, Ronald P; Patel, Rajen; Reichek, Ken; Sehanobish, Kalyan	E-mail correspondence regarding information requested by Dow's legal department in anticipation of litigation in order to provide legal advice	AC, WP
2282	2	09/26/2003	Lai, Shih-Yaw	Johnson, Mark S	Bensason, Selim; Chum, Stephen; Krupp, Stephen; Markovich, Ronald P; Patel, Rajen; Reichek, Ken; Sehanobish, Kalyan	E-mail correspondence reflecting attorney-client communications with S. Krupp and discussing work performed at the request of counsel in anticipation of litigation	AC, WP
2283	1	09/25/2003	Sehanobish, Kalyan	Patel, Rajen	Bensason, Selim; Johnson, Mark S	E-mail correspondence concerning testing requested by M. Glenn in anticipation of litigation	WP

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2284	5	10/11/2003	Lai, Shih-Yaw	Johnson, Mark S	Krupp, Stephen	E-mail correspondence regarding information requested by Dow's legal department in order to provide legal advice in anticipation of litigation	AC, WP
2285	2	06/03/2003	Johnson, Mark S; Fordyce, William	Fordyce, William; Johnson, Mark S; Story, Bruce; Krupp, Stephen; Dekunder, Staci; Kolthammer, Brian W.S		Redaction: E-mail correspondence reflecting attorney-client communications with S. Krupp regarding patent infringement (Removed and produced)	WP
2286	2	06/14/2005	Johnson, Mark S	Trybus, Steven R	Balke, Stephen T; Hazlitt; Kanuch, Bruce; Krupp, Stephen; Lonnie; Reichek, Ken; Turk, Thelma	E-mail reflecting attorney-client privileged communications with S. Trybus	AC
2287	2	08/15/2005	Johnson, Mark S	Redwine, David; Zhou, Zhe	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2288	2	08/15/2005	Zhou, Zhe	Johnson, Mark S; Redwine, David	Coker, Wayne; Conboy, Claire; Hazlitt, Lonnie; Taha, Angela	E-mails concerning testing performed at the request of H. Roper in anticipation of litigation	WP
2289	1	06/10/2004	Patel, Rajen	Hazlitt, Lonnie; Johnson, Mark S; Patel, Rajen		E-mail correspondence regarding test results requested by G. Porter in anticipation of litigation	WP
2290	21	11/24/1997	Patel, Rajen	Hazlitt, Lonnie; Johnson, Mark S; Patel, Rajen		Attached test results requested by counsel in anticipation of prior litigation	WP
2291	1	09/03/2003	Thomson, Kip; Johnson, Mark S	Billings, Mike; Johnson, Mark S; Thomson, Kip		Removed and produced	
2292	2	04/21/2004	Markovich, Ronald P	Chum, Stephen; Johnson, Mark S; Lai, Shih-Yaw; Patel, Rajen		E-mail correspondence containing information collected at the request of G. Porter in anticipation of litigation	WP
2293	1	04/21/2004	Chum, Stephen	Johnson, Mark S; Lai, Shih-Yaw; Patel, Rajen	Markovich, Ronald P	E-mail correspondence containing information collected at the request of G. Porter in anticipation of litigation	WP

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2294	2	04/22/2004	Johnson, Mark S	Chum, Stephen; Lai, Shih-Yaw; Markovich, Ronald P; Patel, Rajen		E-mail correspondence containing information collected at the request of G. Porter in anticipation of litigation	WP
2295	1	06/17/2005	Zhou, Zhe	Johnson, Mark S		E-mail with attached data generated at request of H. Roper in anticipation of litigation	WP
2296	4	06/17/2005	Zhou, Zhe	Johnson, Mark S		Testing performed at the request of H. Roper in anticipation of litigation	WP
2297	1	04/18/2004	Markovich, Ronald P	Johnson, Mark S		E-mail correspondence containing information collected at the request of G. Porter in anticipation of litigation	WP
2298	1	04/19/2005	Johnson, Mark S	Kanuch, Bruce	Hazlitt, Lonnie; Krupp, Stephen	E-mail providing requested information to counsel in order to obtain legal advice	AC
2299	2	04/18/2005				Report generated at the request of counsel in anticipation of litigation	WP
2300	37	03/21/2003	DeKunder, Staci; Wooster, Jeffrey J	Kanuch, Bruce	Hazlitt, Lonnie; Krupp, Stephen	Report attached to e-mail sent to counsel seeking legal advice	AC
2301	29	11/30/1999		Kanuch, Bruce	Hazlitt, Lonnie; Krupp, Stephen	Report attached to e-mail sent to counsel in order to obtain legal advice	AC
2302	1	06/14/2005	Johnson, Mark S	Kanuch, Bruce; Roper, Harry	Balke, Stephen T; Hazlitt; Krupp, Stephen; Lonnie; Reichek, Ken; Trybus, Steven; Williams, Allen	E-mail to attorneys B. Kanuch and H. Roper seeking legal advice	AC
2303	1	04/05/2005	Johnson, Mark S	Fordyce, William; Glenn, Michael L; Korfhage, Glenn; Story, Bruce	Kanuch, Bruce; Krupp, Stephen; Turk, Thelma	E-mail to attorneys seeking legal advice regarding patent infringement	AC
2304	26	04/08/2005	Johnson, Mark S; Kanuch, Bruce M			Presentation prepared by attorneys in anticipation of litigation	WP
2305	1	01/17/2005	Johnson, Mark S	Kanuch, Bruce M; Roper, Harry J; Trybus, Steven R		E-mail to attorneys providing information in order to obtain legal advice	AC
2306	1	11/04/2003	Markovich, Ronald P	Johnson, Mark S		E-mail attaching testing performed at the request of M. Glenn in anticipation of litigation	WP
2307	40	11/04/2003	Markovich, Ronald P	Johnson, Mark S		Testing performed at the request of M. Glenn in anticipation of litigation	WP

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NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2308	1	04/16/2004	Markovich, Ronald P	Johnson, Mark S		E-mail with attached test results collected at the request of G. Porter in anticipation of litigation	AC, WP
2309	40	11/04/2003	Markovich, Ronald P	Johnson, Mark S		Test results attached to an e-mail reflecting attorney-client communications with legal department and collected in anticipation of litigation	AC, WP
2310	1	01/17/2004	Reichek, Ken	Johnson, Mark S		E-mail with attached testing performed at request of M. Glenn in anticipation of litigation	WP
2311	111	09/24/2003	Reichek, Ken			Testing performed at the request of M. Glenn in anticipation of litigation	WP
2312	1	09/24/2003	Patel, Rajen	Sehanobish, Kalyan	Bensason, Selim; Johnson, Mark S	E-mail with attached testing performed at request of M. Glenn in anticipation of litigation	WP
2313	74	09/24/2003	Patel, Rajen	Sehanobish, Kalyan	Bensason, Selim; Johnson, Mark S	Spreadsheet attached to e-mail regarding testing requested by M. Glenn in anticipation of litigation	WP
2314	2	09/25/2003	Johnson, Mark S	Lai, Shih-Yaw	Bensason, Selim; Chum, Stephen; Krupp, Stephen; Markovich, Ronald P; Patel, Rajen; Reichek, Ken; Sehanobish, Kalyan	E-mail correspondence reflecting attorney-client communications with S. Krupp and discussing work performed at the request of M. Glenn in anticipation of litigation	AC, WP
2315	14	09/25/2003		Lai, Shih-Yaw	Bensason, Selim; Chum, Stephen; Krupp, Stephen; Markovich, Ronald P; Patel, Rajen; Reichek, Ken; Sehanobish, Kalyan	Attached patent reflecting attorney-client communications with S. Krupp	AC

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2316	74	09/24/2003	Patel, Rajen	Lai, Shih-Yaw	Bensason, Selim; Chum, Stephen; Krupp, Stephen; Markovich, Ronald P; Patel, Rajen; Reichek, Ken; Sehanobish, Kalyan	Attached privileged testing performed at the request of counsel in anticipation to litigation and reflecting attorney-client communications with S. Krupp	AC, WP
2317	1	05/06/2004	Patel, Rajen	Wooster, Jeffrey	Johnson, Mark S	E-mail correspondence requesting information in order to perform work at the request of G. Porter in anticipation of litigation	WP
2318	1	03/14/2005	Johnson, Mark S	Kanuch, Bruce; Roper, Harry; Trybus, Steven	Korfhage, Glenn; Krupp, Stephen	E-mail to attorneys reflecting attorney-client privileged communications regarding testing performed at the request of H. Roper in anticipation of litigation	AC, WP
2319	1	08/13/2004	Hazlitt, Lonnie	Johnson, Mark S	Reichek, Ken	E-mail with attached testing performed at request of G. Porter in anticipation of litigation	WP
2320	7	06/13/2004	Hazlitt, Lonnie			Testing performed at the request of G. Porter in anticipation of litigation	WP
2321	1	06/13/2004	Reichek, Ken	Hazlitt, Lonnie; Johnson, Mark S		E-mail forwarding testing performed at the request of G. Porter in anticipation of litigation	WP
2322	2	05/29/2003	Story, Bruce; Johnson, Mark S	Beil, Robert; Glenn, Michael L; Hasenbeck, Ken; Kreinberg, Romeo; Schwartz, Roger; Swogger, Kurt; Story, Bruce	Fordyce, William; Vanderhider, Alan	E-mail correspondence regarding analysis performed by counsel and at the request of counsel in anticipation of litigation and providing information to counsel in order to obtain legal advice	AC, WP
2323	1	06/07/2005	Johnson, Mark S	Trybus, Steven		E-mail to outside counsel seeking legal advice	AC
2324	1	06/23/2004	Kummer, Kyle	Johnson, Mark S		E-mail correspondence regarding testing performed at the request of G. Porter in anticipation of litigation	WP
2325	4	06/23/2004	Kummer, Kyle G			Testing performed at the request of G. Porter in anticipation of litigation	WP

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2326	4	05/06/2004	Mcnamee, Gary	Johnson, Mark S		E-mail correspondence providing information gathered in anticipation of litigation at the request of G. Porter in order to obtain legal advice	AC, WP
2327	1	08/12/2005	Zhou, Zhe	Johnson, Mark S; Redwine, David	Conboy, Claire; Taha, Angela	E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2328	21	08/12/2005	Zhou Z			Testing performed at the request of H. Roper in anticipation of litigation	WP
2329	1	01/26/2004	Johnson, Mark S	Porter, Greg	Glenn, Michael; Kanuch, Bruce; Krupp, Stephen	E-mail to G. Porter providing attached reports to obtain legal advice in anticipation of litigation	AC, WP
2330	11	01/26/2004		Porter, Greg	Glenn, Michael; Kanuch, Bruce; Krupp, Stephen	Attached information provided to G. Porter to obtain legal advice in anticipation of litigation	AC, WP
2331	1	01/26/2004	Bert Peters	Porter, Greg	Glenn, Michael; Kanuch, Bruce; Krupp, Stephen	Attached information provided to G. Porter to obtain legal advice in anticipation of litigation	AC, WP
2332	1	01/26/2004	Bert Peters	Porter, Greg	Glenn, Michael; Kanuch, Bruce; Krupp, Stephen	Attached information provided to G. Porter to obtain legal advice in anticipation of litigation	AC, WP
2333	11	01/26/2004	Johnson, Mark S	Porter, Greg	Glenn, Michael; Kanuch, Bruce; Krupp, Stephen	Attached information provided to G. Porter to obtain legal advice in anticipation of litigation	AC, WP
2334	2	01/26/2004		Porter, Greg	Glenn, Michael; Kanuch, Bruce; Krupp, Stephen	Attached information provided to G. Porter to obtain legal advice in anticipation of litigation	AC, WP
2335	1	06/04/2004	Johnson, Mark S	Porter, Greg		Attached information provided to G. Porter to obtain legal advice in anticipation of litigation	AC, WP
2336	1	06/04/2004	Bert Peters	Porter, Greg		Attached information provided to G. Porter to obtain legal advice in anticipation of litigation	AC
2337	4	06/04/2004	Ken Reichek	Porter, Greg		Attached privileged testing performed at the request of counsel in anticipation of litigation and provided to counsel to obtain legal advice	AC, WP

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2338	2	08/31/2003	Johnson, Mark S	Lloyd, Kenny; Reichek, Ken	Dekunder, Staci; Gallagher, Tony; Gibbons, Julie; PetersIII, Herbert	Removed and produced	
2339	1	04/14/2005	Johnson, Mark S	Kanuch, Bruce	Krupp, Stephen	E-mail correspondence regarding information requested by M. Glenn in anticipation of litigation in order to provide legal advice	AC, WP
2340	1	02/03/2005	Zhou, Zhe	Johnson, Mark S; Taha, Angela		E-mail correspondence regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2341	2	12/17/2004	Oswald, Thomas	Johnson, Mark S	Cham, Pak-Meng; Chum, Stephen; Demirors, Mehmet	E-mail correspondence regarding test analysis performed at the request of H. Roper in anticipation of litigation	WP
2342	2	06/10/2004	Patel, Rajen	Hazlitt, Lonnie; Johnson, Mark S		E-mail correspondence regarding testing collected at the request of G. Porter in anticipation of litigation	WP
2343	21	06/10/2004				Testing collected and organized at the request of in-M. Glenn and G. Porter in anticipation of litigation	WP
2344	8	06/10/2004				Testing collected and organized at the request of M. Glenn and G. Porter in anticipation of litigation	WP
2345	6	06/10/2004				Testing collected and organized at the request of M. Glenn and G. Porter in anticipation of litigation	WP
2346	5	06/10/2004				Testing collected and organized at the request of M. Glenn and G. Porter in anticipation of litigation	WP
2347	13	06/10/2004				Testing collected and organized at the request of M. Glenn and G. Porter in anticipation of litigation	WP
2348	13	02/19/1972				Patent used in analysis and testing performed at the request of counsel in anticipation of litigation	WP

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2349	1	02/27/2006	Johnson, Mark S	Kanuch, Bruce; Korfhage, Glenn; Krupp, Stephen; Roper, Harry; Trybus, Steven	Hazlitt, Lonnie; Kolthammer, Brian	E-mail correspondence providing information in order to obtain legal advice	AC
2350	30	12/01/1993	Cady, L.; Hazlitt, Lonnie; Langohr, Michael	Kanuch, Bruce; Korfhage, Glenn; Krupp, Stephen; Roper, Harry; Trybus, Steven		Attached report sent to counsel in order to obtain legal advice	AC
2351	2	11/21/2006	Johnson, Mark S	Barlow, Aaron A; Kanuch, Bruce; Roper, Harry	Hazlitt, Lonnie	E-mail correspondence providing information prepared at the request of counsel in anticipation of litigation in order to obtain legal advice	AC, WP
2352	1	11/21/2006	Johnson, Mark S	Barlow, Aaron A; Kanuch, Bruce; Roper, Harry	Hazlitt, Lonnie	Attached notes prepared at the request of counsel in anticipation of litigation and provided to counsel in order to obtain legal advice	AC, WP
2353	5	11/21/2006		Barlow, Aaron A; Kanuch, Bruce; Roper, Harry	Hazlitt, Lonnie	Attached analysis performed at the request of counsel in anticipation of litigation and provided to counsel in order to obtain legal advice	AC, WP
2354	15	11/21/2006	Wild, L.; Ryle, T.R.; Knobeloch, DC; Peat, I.R.	Barlow, Aaron A; Kanuch, Bruce; Roper, Harry	Hazlitt, Lonnie	Attached article provided to counsel in order to obtain legal advice in anticipation of litigation	AC, WP
2355	18	11/21/2006		Barlow, Aaron A; Kanuch, Bruce; Roper, Harry		Attached patent provided to counsel in order to obtain legal advice in anticipation of litigation	AC, WP
2356	7	11/21/2006	Wild, L.; Ryle, T.	Barlow, Aaron A; Kanuch, Bruce; Roper, Harry	Hazlitt, Lonnie	Attached article provided to counsel in order to obtain legal advice in anticipation of litigation	AC, WP
2357	1	01/08/2004	Gillespie, David	Johnson, Mark S; Reichek, Ken	Perkins, Harolyn	E-mail correspondence regarding testing performed at the request of counsel in anticipation of litigation	WP
2358	1	01/27/2005	Johnson, Mark S	Crown, Alechia; Green, Shayne; Taha, Angela; Zhou, Zhe	Conboy, Claire; Hazlitt, Lonnie; Reichek, Ken	E-mail correspondence regarding analysis and testing performed at the request of H. Roper in anticipation of litigation	WP

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2359	2	01/26/2005				Notes regarding analysis and testing performed at the request of counsel in anticipation of litigation	WP
2360	1	04/29/2005	Trybus, Steven R	Johnson, Mark S; Kanuch, Bruce; Marinelli, Joseph F; Roper, Harry J		E-mail from counsel providing legal advice regarding testing	AC, WP
2361	1	08/05/2003	Johnson, Mark S	Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn	Ramsey, David	E-mail correspondence regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
2362	15	08/04/2003	Johnson, Mark; Billings, Mike; Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree; Wright, Glenn			Presentation regarding analysis and testing performed at the request of M. Glenn in anticipation of litigation	WP
2363	1	06/10/2004	Johnson, Mark S	Dekunder, Staci; Larsen Jr, Douglas; Mcconnell, Dennis; Niemann, Debra; Nietvelt, Paul; Patterson, Leree	Bernier, Robert; Cobler, Brad; Desjardins, Sylvie; Eversdyk, David; Kardos, Lori; Krupp, Stephen	E-mail correspondence regarding analysis and testing performed at the request of G. Porter in anticipation of litigation	WP
2364	24	06/10/2004	Johnson, Mark S			Presentation regarding analysis and testing prepared at the request of G. Porter in anticipation of litigation	WP
2365	1	04/07/2004	Johnson, Mark S	Glenn, Michael L; Kanuch, Bruce	Fordyce, William; Krupp, Stephen; Story, Bruce	E-mail correspondence requesting legal advice and regarding testing performed at the request of counsel in anticipation of litigation	AC, WP
2366	1	09/29/2004	Johnson, Mark S	Glenn, Michael L; Kanuch, Bruce; Story, Bruce	Krupp, Stephen; Porter, Greg	E-mail correspondence reflecting attorney-client communications and regarding analysis performed at the request of counsel in anticipation of litigation	AC, WP

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2367	1	08/05/2005	Johnson, Mark S	Pinkerton, Jack	Niemann, Debra	E-mail regarding testing performed at the request of H. Roper in anticipation of litigation	WP
2368	1	04/20/2004	Johnson, Mark S	Chum, Stephen; Lai, Shih-Yaw; Patel, Rajen	Markovich, Ronald P	E-mail attaching testing in order to request information for G. Porter to provide legal advice in anticipation of litigation	AC, WP
2369	1	04/20/2004	Markovich, Ronald P			Attached chart provided to support request for information in order for G. Porter to provide legal advice in anticipation of litigation	AC, WP
2370	1	04/20/2004	Markovich, Ronald P			Attached spreadsheet provided to support request for information in order for G. Porter to provide legal advice in anticipation of litigation	AC, WP
2371	1	04/05/2006	Johnson, Mark S	Kanuch, Bruce; Korfhage, Glenn; Krupp, Stephen; Roper, Harry; Trybus, Steven	Hazlitt, Lonnie	E-mail correspondence forwarding information prepared at the request of counsel and provided in order to obtain legal advice	AC, WP
2372	15	04/05/2006	Wild, L.; Ryle, T.R.; Knobeloch, DC; Peat, I.R.	Kanuch, Bruce; Korfhage, Glenn; Krupp, Stephen; Roper, Harry; Trybus, Steven	Hazlitt, Lonnie	Attached article sent to counsel in order to obtain legal advice	AC
2373	1	04/05/2006	Johnson, Mark S.			Notes regarding testing performed at the request of counsel in anticipation of litigation	WP
2374	1		Schwartz, Roger			Chart regarding document collection prepared by attorneys in anticipation of litigation.	WP

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2375	10	09/08/1997	Holder, Tim; Johnson, Mark S	Carrington, Susan; Gambrell, Ed; Hasenbeck, Ken; Cuadrado, Juan Carlos; Guarino, Carlo; Kalil, Charles; Korfhage, Glenn; Kreinberg, Romeo; Donoso, Diego; Torres, Tony; Pierce, Jim; Schwartz, Roger; Swogger, Kurt W; Garrett, Gus; Kao, Che	Anderson, Kenneth W; Hazlitt, Lonnie; Jain, Pradeep; Lastovica, John; Schwank, Don; Stuart, Duncan; Swindoll, Robert; Chum, Stephen; Ellebracht, Steve; Huff, Georgia; Krupp, Stephen; McKinney, Ozborne K; Sehanobish, Kalyan; Story, Bruce; Flickenger, John; Ehrhart, Sabra; Docking, Darrel; Dunning, Brian; Falla, Dan; Hagan, Susan; Neuenfeldt, Jan; Perez, Inma; Brolin, Kane; Robson, Ian	Draft report prepared in anticipation of prior litigation	WP

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2376	10	09/08/1997	Holder, Tim; Johnson, Mark S	Carrington, Susan; Gambrell, Ed; Hasenbeck, Ken; Cuadrado, Juan Carlos; Guarino, Carlo; Kalil, Charles; Korfhage, Glenn; Kreinberg, Romeo; Donoso, Diego; Torres, Tony; Pierce, Jim; Schwartz, Roger; Swogger, Kurt W; Garrett, Gus; Kao, Che	Anderson, Kenneth W; Hazlitt, Lonnie; Jain, Pradeep; Lastovica, John; Schwank, Don; Stuart, Duncan; Swindoll, Robert; Chum, Stephen; Ellebracht, Steve; Huff, Georgia; Krupp, Stephen; McKinney, Ozborne K; Sehanobish, Kalyan; Story, Bruce; Flickenger, John; Ehrhart, Sabra; Docking, Darrel; Dunning, Brian; Falla, Dan; Hagan, Susan; Neuenfeldt, Jan; Perez, Inma; Brolin, Kane; Robson, Ian	Report prepared in anticipation of prior litigation	WP
2377	1					Cover page for file containing reports prepared in anticipation of litigation	WP
2378	1	10/21/2005	Kanuch, Bruce M	Wheeler, Scot; Fitzpatrick, Ken; Glenn, Michael L; Johnson, Mark S; Korfhage, Glenn; Kreinberg, Romeo; Krupp, Stephen; Nicholas, Gloria; Schwartz, Roger; Stuart, Duncan; Swogger, Kurt W		E-mail providing legal advice in anticipation of litigation	AC, WP

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2379	4	06/21/2005	Kanuch, Bruce M	Wheeler, Scot; Fitzpatrick, Ken; Glenn, Michael L; Johnson, Mark S; Korfhage, Glenn; Kreinberg, Romeo; Krupp, Stephen; Nicholas, Gloria; Schwartz, Roger; Stuart, Duncan; Swogger, Kurt W		Attached report providing legal advice in anticipation of litigation	AC, WP
2380	4	10/21/2005	Roper, Harry J; Trybus, Steven R.; Marinelli, Joseph F.			Draft legal filing prepared in anticipation of litigation	WP
2381	3	06/08/2005	Kanuch, Bruce M	Jennings, Peter		Draft report providing legal advice prepared in anticipation of litigation	AC, WP
2382	38		Ward, Dan; Teh, Joo; Ho, Kam; Marler, Jamie; Aubee, Norman			Removed from privilege log. Document is non-responsive attachment to privileged but non-responsive e-mail communication regarding unrelated patents	
2383	3	07/19/2005	Kanuch, Bruce M; Schwartz, Roger	Kreinberg, Romeo; Kanuch, Bruce M; Stuart, Duncan; Glenn, Michael L	Schwartz, Roger; Fitzpatrick, Ken; Nichols, Jamie; Stuart, Duncan; Glenn, Michael	E-mail correspondence providing draft report to provide legal advice in anticipation of litigation	AC, WP
2384	2	06/20/2005	Kanuch, Bruce M	Kreinberg, Romeo; Kanuch, Bruce M; Stuart, Duncan; Glenn, Michael L	Schwartz, Roger; Fitzpatrick, Ken; Nichols, Jamie; Stuart, Duncan; Glenn, Michael	Attached draft report providing legal advice in anticipation of litigation	AC, WP
2385	2	06/21/2005	Kanuch, Bruce M	Schwartz, Roger; Stuart, Duncan; Glenn, Michael L	Stuart, Duncan; Glenn, Michael	E-mail correspondence providing draft report to provide legal advice in anticipation of litigation	AC, WP
2386	2	06/21/2005	Kanuch, Bruce M	Schwartz, Roger; Stuart, Duncan; Glenn, Michael L	Stuart, Duncan; Glenn, Michael	Attached draft report providing legal advice in anticipation of litigation	AC, WP
2387	1	04/14/2005	Kanuch, Bruce M	Schwartz, Roger	Glenn, Michael; Johnson, Mark S	E-mail providing Q&A memo providing legal advice in anticipation of litigation	AC, WP
2388	3	04/13/2005	Kanuch, Bruce M	Schwartz, Roger		Q&A providing legal advice in anticipation of litigation	AC, WP

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2389	1	04/14/2005	Johnson, Mark S	Kanuch, Bruce M	Krupp, Stephen	E-mail providing information requested by counsel in anticipation of litigation	WP
2390	1	04/08/2005	Turk, Thelma	Johnson, Mark S; Schwartz, Roger; Wright, Glenn; Fordyce, William; Story, Bruce; Krupp, Stephen; Kanuch, Bruce M; Glenn, Michael L; Korfhage, Glenn; Roper, Harry J; McAlindon, Julie; Turk, Thelma		E-mail requesting meeting to request legal advice	AC
2391	7	11/23/1998 - 05/12/2000	Lai, Shih-Yaw			Data book documenting testing performed at the request of A. Barlow in anticipation of prior litigation	WP
2392	20	09/16/1999	Kale, Larry			Lab notebook documenting work performed in anticipation of prior litigation at the request of O. McKinney and containing memos to O. McKinney reflecting and/or requesting legal advice	AC, WP
2393	50	03/29/99 - 05/08/99	Oswald, Tom			Removed and produced	
2394	2	06/03/2004	Johnson, Mark S			Slides regarding patent enforcement prepared at the request of counsel in anticipation of litigation	WP
2395	23	09/16/1999	Kale, Larry			Lab notebook documenting work performed in anticipation of prior litigation at the request of O. McKinney and containing memos to O. McKinney reflecting and/or requesting legal advice	AC, WP
2396	1					Internal file history containing handwritten notes reflecting attorney-client communications with S. Krupp, Esq.	AC
2397	1					Internal file history containing handwritten notes reflecting attorney-client communications with S. Krupp	AC

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2398	1					Internal file history containing handwritten notes reflecting attorney-client communications with S. Krupp	AC
2399	19	06/19/1998	Plotecher, Gary	Warrick, Noreen D; Peil, Kevin; Wilson, David		Draft patent application unrelated to patents-in-suit provided with request for information in order to provide legal advice	AC
2400	1	09/26/1991	Lai, Shih-Yaw; Wilson, J.; Knight, George W; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2401	1	09/26/1991	Lai, Shih-Yaw; Wilson, J.; Knight, George W; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2402	1	09/26/1991	Lai, Shih-Yaw; Wilson, J.; Knight, George W; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2403	1	09/26/1991	Lai, Shih-Yaw; Wilson, J.; Knight, George W; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2404	1	09/27/1991	Lai, Shih-Yaw; Wilson, J.; Knight, George W; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2405	1	09/26/1991	Lai, Shih-Yaw; Knight, George W; Chum, Stephen; Wilson, J.; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2406	1	09/26/1991	Lai, Shih-Yaw; Knight, George W; Chum, Stephen; Wilson, J.; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2407	1	09/26/1991	Lai, Shih-Yaw; Knight, George W; Chum, Stephen; Wilson, J.; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2408	1	09/26/1991	Lai, Shih-Yaw; Knight, George W; Chum, Stephen; Wilson, J.; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC

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2409	1	09/26/1991	Lai, Shih-Yaw; Knight, George W; Chum, Stephen; Wilson, J.; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2410	1	09/26/1991	Lai, Shih-Yaw; Knight, George W; Chum, Stephen; Wilson, J.; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2411	1	09/26/1991	Lai, Shih-Yaw; Knight, George W; Chum, Stephen; Wilson, J.; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2412	1	09/26/1991	Lai, Shih-Yaw; Knight, George W; Chum, Stephen; Wilson, J.; Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2413	3	09/26/1991	Stevens, James	White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2414	1	09/19/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2415	1	09/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2416	1			White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2417	1	09/19/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2418	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2419	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC

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2420	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2421	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2422	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2423	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2424	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2425	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2426	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2427	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2428	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2429	1	09/26/1991		White, L Wayne		Invention disclosure submitted to Dow legal department for application related to patents-in-suit	AC
2430	3	03/03/2002	Bai, J Benjamin; Hazlitt, Andrea	Abdon, Robert L; Bai, J Benjamin		E-mail correspondence between counsel providing legal advice regarding prosecution of the '919 application	AC
2431	6	06/11/2002				Draft of '919 patent application prepared by or for counsel and reflecting attorney-client communications with B. Bai, Esq.	AC

Dow's Log of Documents Withheld from Production on Grounds of Privilege in Civil Action 05-737

NO.	PGS	DATE	AUTHOR	RECIPIENT	CC	DESCRIPTION	REASON WITHHELD
2432	7	03/11/2002				Draft of '919 patent application prepared by or for counsel and reflecting attorney-client communications with B. Bai, Esq.	AC
2433	6	12/10/2001				Draft of '919 patent application prepared by or for counsel and reflecting attorney-client communications with B. Bai, Esq.	AC
2434	5	07/25/2001				Draft of '919 patent application prepared by or for counsel and reflecting attorney-client communications with B. Bai, Esq.	AC
2435	46					Draft of '919 patent application prepared by or for counsel and reflecting attorney-client communications with B. Bai, Esq.	AC
2436	50	10/07/2003	Reichek, Ken			Lab notebook documenting testing performed at the request of M. Glenn in anticipation of litigation	WP
2437	50	11/04/2003	Reichek, Ken			Lab notebook documenting testing performed at the request of M. Glenn in anticipation of litigation	WP
2438	50	03/15/2004	Reichek, Ken			Lab notebook documenting testing performed at the request of G. Porter in anticipation of litigation	WP
2439	74	04/15/2004	Reichek, Ken			Lab notebook documenting testing performed at the request of G. Porter in anticipation of litigation	WP
2440	73	04/15/2004	Reichek, Ken			Lab notebook documenting testing performed at the request of G. Porter in anticipation of litigation	WP
2441	50	10/07/2003	Reichek, Ken			Lab notebook documenting testing performed at the request of M. Glenn in anticipation of litigation	WP
2442	50	11/04/2003 - 03/31/2004	Reichek, Ken			Lab notebook documenting testing performed at the request of M. Glenn and G. Porter in anticipation of litigation	WP
2443	74	06/02/2004 - 03/03/2005	Reichek, Ken			Lab notebook documenting testing performed at the request of G. Porter and H. Roper in anticipation of litigation	WP