مؤسسة مياه بيروت وجبل لبنان

إمداد إقليم الخروب بالمياه ضمن نطاق
مؤسسة مياه بيروت وجبل لبنان

مصلحة الصفقات والشؤون القانونية

فرنسوا بشعلاني

مصلحة المشاريع

المهندس احمد سرحال

المدير العام بالإنابة

المهندس ربيع خليفة

وافق مجلس الإدارة بقراره رقم : ٩٧

تاريخ : ٢٠٢٥/١٠/١٣

محتويات الملف المسلّم لتقديم العروض

تسلّم المؤسسة إلى كل من ينوي الإشتراك في هذا الإلتزام وبناءً على طلبه المستندات التالية:

1- دفتر الشروط هذا

2- جدول الأسعار وتقدير الكميات.

3- نموذج التصريح / التعهد.

4- نموذج تصريح النزاهة.

5- نموذج التعهد برفع السرّية عن الحسابات المصرفية المتعلقة بهذا الالتزام.

6- تصريح بمعاينة مواقع العمل نافي للجهالة.

7- غلاف مدوّن عليه من قبل المؤسسة موضوع الالتزام وتاريخ فض العروض مع إسم وعنوان المؤسسة.

1- دفتر الشروط

نوع الشراء : مناقصة عمومية على اساس السعر الادنى.

مدة الإلتزام : ستة اشهر من تاريخ توقيع العقد.

غرامة التأخير : 1/1000 واحد بالالف من قيمة الصفقة الاجمالية.

قيمة ضمان العرض : /3.250.000.000/ل.ل. ثلاثة مليارات ومئتان وخمسون مليون ليرة لبنانية.

قيمة ضمان حسن التنفيذ : 10% من قيمة العقد.

العارضون المقبولون : المتعهدون اللبنانيون الذين يستوفون الشروط المذكورة في هذا الدفتر.

فهرس

1- تعاريف عامة:

في هذا الدفتر ترمز كلمة:

- "المؤسسة" : إلى مؤسسة مياه بيروت وجبل لبنان.
- "العارض" : إلى الشخص الطبيعي أو المعنوي الذي يقدم عرضاً.
- "العرض" : إلى مجموع المستندات الموجودة في ملف التعهد.
- "مناقصة عمومية" : إلى منافسة بشأن صفقة معلن عنها ومفتوحة لكل شخص طبيعي أو معنوي يستوفي الشروط.
- "العارض الافضل" : الى العارض الذي يحتفظ مؤقتاً بعرضه بوصفه العارض الانسب والادنى سعراً لتنفيذ الصفقة.
- "الملتزم"، "المتعاقد" : إلى المتعهد الذي أسند إليه الالتزام بصورة نهائية.
- "مندوب المؤسسة"، "مندوب الإدارة" : إلى اي شخص طبيعي أو معنوي تكلفه المؤسسة مراقبة تنفيذ الالتزام.
- "أشغال"، "منشآت" : إلى مختلف الأشغال والمواد والمنشآت التي يتوجب تنفيذها ضمن الالتزام.
- "مستندات الإلتزام" : وتشمل :
  - 1: دفتر الشروط هذا
  - 2: جدول الأسعار وتقدير الكميات
  - 3: تصريح / تعهد
  - 4: تصريح النزاهة
  - 5: تعهد برفع السرية عن الحسابات المصرفية
  - 6: تصريح بمعاينة موقع الاعمال ناقي للجهالة
- "وكيل الملتزم" : هو الشخص المنتدب من قبل الملتزم بموجب كتاب تفويض ليداوم على الورشة ويجب أن يكون هذا الوكيل مقبولاً من قبل المؤسسة.
- "الأشغال" : وتشمل تقديم اليد العاملة والمواد والتجهيزات والمعدات اللازمة للتنفيذ حسب المستندات وتشمل:

أ- الأشغال الدائمة: وهي المطلوب تنفيذها وتسليمها حسب المواصفات المطلوبة عند نهاية مهلة الالتزام وهذه الأشغال تدخل ضمن الكشوفات.

ب- الأشغال المؤقتة: وهي الأشغال الإضافية المتوجب القيام بها لحسن تنفيذ الأشغال الدائمة والتي يجب إزالتها بعد إنتهاء الأشغال الدائمة أو إعادتها إلى ما كانت عليه قبل البدء في الأشغال ولا يدفع بدل هذه الأشغال المؤقتة على حدة بل يجب إدخال تكاليفها ضمن أسعار الالتزام.

ج- أشغال إضافية: وتشمل اي جزء من الأشغال لا ينص عليه جدول الأسعار ويعتبر من قبل المؤسسة ضرورياً لإكتمال الالتزام الأساسية.

- "الانشاءات" : وتشمل الجسور والعبارات والجدران والأبنية والأقنية وأنابيب الخدمة من مياه وكهرباء وتصريف مياه سطحية إلخ... وغير ذلك من المعالم الموجودة ضمن الأشغال.
- "الطرق" : وهي الأماكن العامة المخصصة لمرور الآليات أو المشاة.
- "الرصيف" : الجزء من الطريق العام المخصص للمشاة.
- "الخرائط" : هي الخرائط المبدئية المرفقة بدفتر الشروط.
- "الخرائط التنفيذية" : وهي الخرائط المحضرة من قبل الملتزم والمصدقة للتنفيذ من قبل الإدارة والتي تبين أماكن العمل وتفاصيل الأشغال التي ينبغي إنجازها.

2- موضوع الالتزام:

عمليات الحفر والردم وتقديم وتركيب قساطل من الفونت دوكتيل (FD) والحديد بطول إجمالي يبلغ 2.200 متر تقريباً مع القطع اللازمة للتمديد كافة بغية تمديد خط ضخ من محطة الضخ في بمري الى الخزان في بسابا.
تقديم ونقل وتركيب قساطل من البولايثلين قطر 63 ملم بطول 2.200 لزوم خط المراقبة بين محطة الضخ وخزان بسابا الرئيسي.
وتتضمن الاشغال:

- تمديد خط الضخ الذي يربط محطة الضخ في بمري والخزان في بسابا.

يقوم المتعاقد بتقديم القساطل والقطع والمسكورة والقساطل والاكسسوارات اللازمة كافة (اكواع - وصلات - جوانات - سكورة - عدادات - طاردات هواء) وجهاز تمديد الصدمات وكل المواد الأخرى اللازمة لتنفيذ الأشغال على أكمل وجه وفق الشروط الفنية المنصوص عليها في هذا الدفتر.

3- الرجوع الى النصوص العامة:

تطبق بكل ما لا يتعارض وأحكام دفتر الشروط هذا:

1- دفتر الشروط النموذجي الصادر عن هيئة الشراء العام قبل الاعلان عن الصفقة.
2- قانون الشراء العام رقم 2021/244
3- النظام المالي في مؤسسة مياه بيروت وجبل لبنان بموجب المرسوم الرقم 14637 تاريخ 2005/6/16.

4- طريقة التلزيم:

يجري التلزيم بطريقة المناقصة العمومية على أساس السعر الافرادي.
يقدم العارض عرضه بالليرة اللبنانية.

5- درس مستندات الإلتزام ومعاينة مواقع العمل:

يتوجب على كل عارض يرغب الإشتراك بهذا الالتزام أن يدرس بدقة مستندات هذا الالتزام ويعاين مناطق العمل ليطّلع على الحالة الراهنة من جميع الوجوه، إن من حيث طبيعة الأشغال ونوعها وكمياتها أو من مصادر المواد والتجهيزات المطلوب تقديمها وصعوبات التنفيذ.

يعتبر تقديم العرض تسليماً صريحاً من قبل العارض بأنه درس مستندات الالتزام وأصبح يلمّ تمام الإلمام بظروف العمل المحلية وطبيعة الأشغال وأن العرض المقدم منه قد أخذ جميع الأمور بعين الإعتبار، كما وأنه يملك الإمكانات والمقدرة اللازمة لأدائه على أكمل وجه خلال المدة المحددة في هذا الدفتر.

6- العارضون المقبولون:

يتوجب على كل عارض يرغب في الإشتراك بالإلتزام أن يرفق بطلبه:

- تصريحاً / تعهد خطياً حسب النموذج المرفق، يبدي فيه رغبته بالإشتراك في الإلتزام.
- تصريح النزاهة حسب النموذج المرفق.
- تعهداً خطياً حسب النموذج المرفق، يقرّ فيه العارض برفع السرية عن الحسابات المصرفية المتعلقة بهذا الالتزام.
- تصريح بمعاينة موقع الاعمال نافي للجهالة.

كما على المتعهد أن يتقيد بقانون الشراء العام رقم 2021/244.

على العارضين الذين يتقدمون لهذا الالتزام بصفة شركاء ان يقدموا مع عرضهم عقد الشراكة القانوني مسجلاً لدى الكاتب العدل يصرحون فيه انهم متكافلون ومتضامنون بكامل المسؤوليات العائدة لتنفيذ الالتزام، وكل وثيقة يوقعها احدهم تعتبر موقعة منهم جميعاً في ما يعود لتنفيذ هذا الالتزام.

7- طلبات الاستيضاح:

يحق للعارض تقديم طلب استيضاح خطّي حول دفتر الشروط خلال مهلة تنتهي قبل عشرة أيام من تاريخ تقديم العروض، على المؤسسة الإجابة خلال مهلة تنتهي قبل ستة أيام من الموعد النهائي لتقديم العروض. ويُرسل الإيضاح خطيّاً، في الوقت عينه، من دون تحديد هوية مُصدر الطلب، إلى جميع العارضين الذين زوّدتهم الجهة الشارية بملفات التلزيم، وتطبق أحكام المادة 21 من قانون الشراء العام في حال ارتأت الإدارة اجراء تعديلات على دفتر الشروط لأي سبب كان أو بمبادرة منها أم نتيجة لطلب استيضاح مقدم من احد العارضين، وفي كل ما يتعلق بعقد الإجتماعات مع العارضين، كما يُمكن للمؤسسة، عند الاقتضاء، تحديد موعد معيّن للعارضين المحتملين لمعاينة الموقع.

8- تقديم العروض:

1- على العارضين الذين تتوافر فيهم الشروط المطلوبة والراغبين بالإشتراك في هذا الإلتزام أن يستحصلوا على مستندات التلزيم من مصلحة الصفقات والشؤون القانونية في مؤسسة مياه بيروت وجبل لبنان في الطابق الأول من مركز المؤسسة الكائن في وادي خطار – الحازمية – قرب مستشفى قلب يسوع.

2- تقدم العروض وفقاً للتفصيل التالي:

يوضع العرض في غلافين مختومين، يكتب على الغلاف الأول "مستندات" وعلى الغلاف الثاني "بيان أسعار" ويذكر على كل غلاف محتوياته وموضوع الإلتزام وتاريخه واسم العارض.

يتضمن الغلاف الأول:

1- تصريح / تعهد يقرّ فيه العارض بأنه درس مستندات الإلتزام ويبدي إستعداده للتقيد بشروطه كافة بكل دقة وأمانة.

2- تصريح النزاهة.

3- تصريح بمعاينة موقع الاعمال نافي للجهالة.

4- إيصالاً صادراً عن مؤسسة مياه بيروت وجبل لبنان يبيّن أن العارض دفع البدل المقرر لقاء تسليمه نسخة عن دفتر الشروط هذا.

5- نسخة عن دفتر الشروط هذا مؤشر من العارض على كل صفحة من صفحاته وموقع ومؤرخ منه على الصفحة الأخيرة.

6- ضمان العرض بموجب كتاب ضمان مصرفي صادر عن مصرف مقبول من الدولة اللبنانية على أن يذكر عليه أنه يتجدّد حكماً إذا لم ترد المؤسسة موافقتها على إلغائه، أو بموجب إيصال يبيّن أن قيمة ضمان العرض دفعت إلى صندوق المؤسسة نقداً او بموجب شيك.

7- إفادة تجارية تبيّن فيها صاحب الحق المفوض بالتوقيع عن العارض ونموذج توقيعه.

8- التفويض القانوني إذا وقع العرض شخص غير الشخص الذي يملك حق التوقيع عن العارض بحسب الإفادة التجارية، مصدق لدى الكاتب العدل.

9- سجل عدلي للمفوض بالتوقيع أو "من يمثله قانوناً" لا يتعدى تاريخه الثلاثة أشهر من تاريخ جلسة فض العروض، خالٍ من اي حكم شائن.

10- عقد الشراكة مصدق لدى الكاتب العدل في حال توجبه.

11- شهادة تسجيل العارض لدى مديرية الضريبة على القيمة المضافة إذا كان خاضعاً لها، أو شهادة عدم التسجيل إذا لم يكن خاضعاً، وفي هذه الحالة يلتزم العارض بسعره وان اصبح مسجلاً في الضريبة على القيمة المضافة خلال فترة التنفيذ.

12- شهادة تسجيل العارض لدى وزارة المالية – مديرية الواردات.

13- براءة ذمة من الصندوق الوطني للضمان الاجتماعي شاملة أو مسالحة للاشتراك في الصفقات العمومية" مسالحة بتاريخ جلسة فض العروض تفيد بان العارض سدد جميع اشتراكاته (يجب ان يكون العارض مسجلاً في الصندوق

الوطني للضمان الاجتماعي وترفض كل إفادة يذكر عليها عبارة "مؤسسة غير مسجلة").(نسخة اصلية أو صورة طبق الأصل مصدقة من قبل المرجع المختص).

14- إفادة صادرة عن البلدية التي يقع المقرّ الحالي للعارض ضمن نطاقها، تفيد انه سدد كامل الرسوم البلدية المتوجبة عليه عن العام السابق.

15- إفادة شاملة صادرة عن السجل التجاري تبين: المؤسسين والأعضاء والمساهمين أو الشركاء، المفوضين بالتوقيع، المدير، رأس المال، نشاط العارض والتوقيعات الجارية لا يتعدى تاريخها ستة اشهر من تاريخ جلسة فض العروض.

16- إفادة صادرة عن المرجع المختص تثبت أن العارض ليس في حالة إفلاس لا يتعدى تاريخها ستة اشهر من تاريخ جلسة فض العروض.

17- إفادة صادرة عن المرجع المختص تثبت أن العارض ليس في حالة تصفية قضائية لا يتعدى تاريخها ستة اشهر من تاريخ جلسة فض العروض.

18- تصريح من العارض يبين فيه صاحب /اصحاب الحق الاقتصادي وفقاً للنموذج م18 الصادر عن وزارة المالية. (كل شخص طبيعي يملك أو يسيطر فعلياً في المحصلة النهائية على النشاط الذي يمارسه العارض، بصورة مباشرة أو غير مباشرة، سواء كان هذا العارض شخص طبيعي أو معنوي).

19- إفادة انتساب من نقابة مقاولي الاشغال العامة والبناء اللبنانية عن العام الذي يجري فيه التلزيم.

20- براءة ذمة من نقابة مقاولي الاشغال العامة والبناء اللبنانية تفيد ان المقاول قد سدد جميع الرسوم المتوجبة عليه عن العام الذي يجري فيه التلزيم.

21- إفادة تثبت ان المهندس قد سدّد آخر اشتراك مستحق لدى نقابة المهندسين وذلك للمهندسين المقاولين والشركات أو المؤسسات المصنفة على اسم مهندس.

22- إفادة أو أكثر صادرة عن إدارات عامة أو مؤسسات عامة أو جهة خارجية (مصدقة حسب الأصول) تبين ان العارض قد باشر وأنهى خلال السنوات العشرة الأخيرة تنفيذ أشغال مماثلة لتمديدات مائية بأقطار حد أدنى 400 ملم كمتعهّد رئيسي.

<u>يتضمن الغلاف الثاني:</u>

1- تعهّداً بقرّ فيه العارض برفع السرّية عن الحسابات المصرفية المتعلقة بهذا الالتزام.
2- جدول الأسعار وتقدير الكميات بعد تكملتهما في الأماكن المخصصة لهذه الغاية.

<u>يتضمن الغلاف الثالث:</u>

توضع الغلافات المذكورة ضمن غلاف ثالث موحّد مسلّم من المؤسسة مع ملف الإلتزام مختوم باسم مؤسسة مياه بيروت وجبل لبنان ومدوّن عليه موضوع الإلتزام. يلصق ويغلق هذا الغلاف من قبل العارض دون اية عبارة أو إشارة.

3- تسليم العروض:

1- ترسل العروض بواسطة البريد العام أو الخاص المخفر أو باليد مباشرة وذلك في المركز الرئيسي - شارع سامي الصلح - ملك شدراوي - الطابق الرابع.

2- يُحدد الموعد النهائي لتقديم العروض وفق ما ينص عليه الإعلان المتعلق بهذه الصفقة، والمنشور على المنصة الالكترونية المركزية لهيئة الشراء العام. (يكون موعد جلسة التلزيم فوراً عند إنتهاء مهلة تقديم العروض).

3- تُزوّد المؤسسة العارض بإيصال يُبيّن فيه رقمٌ تسلسليٌ بالإضافة إلى تاريخ تسلُّم العرض بالساعة واليوم والشهر والسنة.

4- تُحافظ المؤسسة على أمن العرض وسلامته وسريته، وتكفل عدم الاطلاع على محتواه إلا بعد فتحه وفقاً للأصول.

5- لا يُفتح أيُ عرض تتسلّمه المؤسسة بعد الموعد النهائي لتقديم العروض، بل يُعاد مختوماً إلى العارض الذي قدّمه.

6- لا يحق للعارض إذا تقدم بأكثر من عرض واحد تحت طائلة رفض كل عروضه.

ملاحظات هامة

أ- يملأ العارض جدول الأسعار وتقدير الكميات والتعهد والتصريح بدون أي تحشية أو حك أو شطب أو تطريس أو زيادة كلمات أو أرقام غير موقع تجاهها. يرفض كل عرض يذكر فيه كلمة ضمّ أو حسم ويستعاض عن الأولى بعبارة زيادة على الأسعار والثانية بعبارة تنزيل على الأسعار.

ب- لا يحق للعارض إجراء أي تعديل على جدول الأسعار وتقدير الكميات الموضوعين من قبل الإدارة ما عدا تكملتهما في الأماكن المخصصة لهذه الغاية.

ج- لا يحق للعارض إسترداد أي وثيقة ترفق بعرضه بإستثناء المستندات التي تقرر لجنة التلزيم إعادتها إليه.

د- إن السعر المقدم يشمل سعر الكلفة والجمرك والمرفأ والنقل والتفريغ والتأمين واليد العاملة والربح وسواها وكذلك جميع الضرائب والرسوم.

هـ- يجب أن تكون المستندات المحلية المقدمة من العارض أصلية او صورة عنها على ان يبرز العارض الأصلية خلال جلسة فض العروض ويصدق عليها رئيس لجنة التلزيم.

و- عند حصول أي تناقض بين الأسعار تعتمد الأسعار الإفرادية المفقطة بالأحرف وفي حال التباين بين السعر الإجمالي والسعر الإفرادي يعتمد السعر الإفرادي. في حال التباين بين أي مستند والسعر الإفرادي المدون بالأحرف على جدول الأسعار يؤخذ بالسعر الإفرادي المدون بالأحرف.

9- مدة صلاحية العروض:

يبقى العارض مرتبطاً بعرضه تجاه المؤسسة لمدة 60 يوماً إعتباراً من التاريخ المحدد لفض العروض ولا يحق له الرجوع عن عرضه كما لا يحق له المطالبة بأي تعويض أو عطل أو ضرر من جراء عدم تصديق الالتزام ولا يصبح العارض متعاقداً نهائياً إلا بعد تصديق الالتزام من المراجع المختصة وإبلاغه قرار إسناد الالتزام إليه.

وإذا لم يبلّغ العارض الذي رسا عليه الإلتزام مؤقتاً تصديق الالتزام خلال فترة 60 يوماً يمكن لهذا العارض التخلي عن عرضه بواسطة إعلام خطي، وعندها يعاد إليه ضمان العرض. أما إذا لم يستعمل العارض هذا الحق قبل تبليغه قرار إسناد الالتزام فإنه يصبح ملزماً نهائياً تجاه المؤسسة بموجب هذا التبليغ.

10- فتح وتقييم العروض:

في اليوم المحدد لفض العروض تعمد لجنة التلزيم خلال جلسة علنية إلى فصل العروض غير المطابقة شكلاً وتورد ذكرها في المحضر ثم تشرع بفض باقي العروض كما يلي:

-تفض اللجنة غلافات المستندات وتعمد إلى دراسة محتواها.

-يمكن للجنة التلزيم الاستعانة بخبراء من خارج أو داخل الإدارة للمساعدة على التقييم الفني والمالي عند الإقتضاء، وذلك بقرار من المرجع الصالح لدى المؤسسة. يخضع اختيار الخبراء من خارج الإدارة إلى أحكام قانون الشراء العام.

-يلتزم الخبراء السرية والحياد في عملهم ولا يحق لهم أن يقرّروا بإسم اللجنة أو أن يشاركوا في مداولاتها أو أن يفصحوا عنها علانية، ويمكن دعوتهم للاجتماع والشرح من قبل الجهات المعنية. كما يتوجّب على الخبراء تقديم تقرير خطي للجنة يُضمّ إلزامياً إلى محضر التلزيم.

- في حال التباين في الآراء بين أعضاء اللجنة، تؤخذ القرارات بأغلبية أعضائها ويُدوّن أي عضو مخالف أسباب مخالفته.

يحق لجميع العارضين المشاركين في عملية التلزيم أو لممثليهم المفوّضين وفقاً للأصول، كما يحق للمراقب المنتدب من قبل هيئة الشراء العام حضور جلسة فتح العروض. كما يمكن للمؤسسة دعوة وسائل الإعلام لحضور هذه الجلسة على أن تلحظ ذلك في ملف التلزيم.

- بعد هذه الدراسة تستبعد من المنافسة العروض التي حكمت عليها لجنة التلزيم بعدم القبول وتعتبر غلافات الأسعار العائدة لها ملكاً للمؤسسة.

- أما العروض المقبولة فتفتح غلافات الأسعار العائدة لها في جلسة بحضور العارضين ويقرأ محتواها علناً وتعلن النتيجة مؤقتاً.

يسند الالتزام مؤقتاً الى من قدم أدنى الأسعار، وفي حال تقدمت عدة عروض بذات السعر الأدنى يصار إلى اعتماد القرعة لاختيار العارض الذي يسند اليه الالتزام مؤقتاً.

على رئيس اللجنة وعلى كل من اعضائها أن يتنحى عن مهامه في اللجنة في حال وقع بأي وضع من أوضاع تضارب المصالح أو توقّع الوقوع فيه، وذلك فور معرفته بهذا التضارب.

تُفتح العروض بحسب الآلية التالية:

يتم فض الغلاف الخارجي الموحّد لكل عارض على حدة وإعلان اسمه ضمن المشاركين في الصفقة، وذلك وفق ترتيب الأرقام التسلسلية المُسجلة على الغلافات الخارجية والمسلّمة للعارضين.

1- يتم فض الغلاف رقم (1) (الوثائق والمستندات الإدارية) وفرز المستندات المطلوبة والتدقيق فيها تمهيداً لتحديد وإعلان أسماء العارضين المقبولين شكلاً والمؤهلين للاشتراك في بيان مقارنة الأسعار.

2- يجري فض الغلاف رقم (2) (بيان الأسعار) للعارضين المقبولين شكلاً كلّ على حدة وإجراء العمليات الحسابية اللازمة، وتدوين السعر الإجمالي لكل عارض بما فيه الضريبة على القيمة المضافة في حال كان العارض خاضعاً لها، تمهيداً لإجراء مقارنة وإعلان اسم الملتزم المؤقت.

3- تُصحّح لجنة التلزيم أيّ اخطاء حسابية محضة تكتشفها أثناء فحصها العروض المقدّمة وفقاً لأحكام دفتر الشروط، وتبلّغ التصحيحات إلى العارض المعني بشكل فوري.

4- يمكن للجنة التلزيم، في اي مرحلة من مراحل إجراءات التلزيم، أن تطلب خطياً من العارض إيضاحات بشأن المعلومات المتعلّقة بمؤهلاته أو بشأن عروضه، لمساعدتها في التأكّد من المؤهّلات أو فحص العروض المقدّمة وتقييمها.

5- تُسجّل وقائع فتح العروض خطياً في محضر يوقّع عليه رئيس وأعضاء لجنة التلزيم، كما توضع لائحة بالحضور يوقّع عليها المشاركون من ممثّلي المؤسسة وهيئة الشراء العام، والعارضين وممثليهم على أن يشكّل ذلك إثباتاً على حضورهم. تُدرج كل المعلومات والوثائق المتعلّقة بوقائع الجلسة في سجل إجراءات الشراء المنصوص عليه في المادة 9 من قانون الشراء العام.

6-لا يمكن طلب إجراء أو السماح بإجراء اي تغيير جوهري في المعلومات المتعلّقة بالمؤهلات أو بالعرض المقدّم، بما في ذلك التغييرات الرامية إلى جعل من ليس مؤهّلاً من العارضين مؤهّلاً أو جعل عرض غير مستوفٍ للمتطلبات مستوفياً لها.

7- لا يمكن إجراء أيّ مفاوضات بين المؤسسة أو لجنة التلزيم والعارض بخصوص المعلومات المتعلقة بالمؤهلات أو بخصوص العروض المقدّمة، ولا يجوز إجراء أي تغيير في السعر إثر طلب استيضاح من أي عارض.

8- تُدرج جميع المراسلات التي تجري بموجب هذه المادة في سجل إجراءات الشراء بحسب المادة9 من قانون الشراء العام.

9- في حال كانت المعلومات أو المستندات المقدّمة في العرض ناقصة أو خاطئة او في حال غياب وثيقة معيّنة، يجوز للجنة التلزيم الطلب خطّياً من العارض المعني توضيحات حول عرضه، أو طلب تقديم أو استكمال المعلومات أو الوثائق ذات الصلة خلال فترة زمنية محدّدة، شرط أن تكون كافة المراسلات خطية واحترام مبادئ الشفافية والمساواة في المعاملة بين العارضين في طلبات التوضيح أو الاستكمال الخطية، ومع مراعاة أحكام الفقرة 3 من البند الثاني من المادة 21 من قانون الشراء العام.

11- شروط الاسعار:

يجب أن تشتمل الأسعار على جميع المصاريف والمطالبات والحقوق المترتبة مهما كان نوعها.

على العارض ان يذكر في جدول الأسعار وتقدير الكميات قيمة الضريبة على القيمة المضافة بشكل واضح منعاً لأي التباس.

12- استبعاد العارض:

تستبعد الجهةُ الشارية العارض من إجراءات التلزيم بسبب عرضه منافع او من جرّاء ميزة تنافسية غير منصفة أو بسبب تضارب المصالح وذلك في احدى الحالتين المنصوص عنهما في المادة الثامنة من قانون الشراء العام.

13- حظر المفاوضات مع العارضين:

تُحظَّر المفاوضات بين الجهة الشارية أو لجنة التلزيم وأي من العارضين بشأن العرض الذي قدّمه ذلك العارض.

14- الأنظمة التفضيلية:

خلافاً لأي نص آخر، يمكن إعطاء العروض المتضمنة سلعاً أو خدمات ذات منشأ وطني أفضلية بنسبة //10// عشرة بالمئة عن العروض المقدّمة لسلع أو خدمات أجنبية. تُعطى الأفضلية لمكوّنات العرض ذات المنشأ الوطني.

15- الطوابع القانونية:

تلصق على مستندات العروض الطوابع القانونية المفروضة وتعطّل وفق الأصول.

ان كافة الطوابع والرسوم التي تتوجب وفقًا للأنظمة والقوانين المرعية الإجراء الناتجة عن هذا الإلتزام هي على عاتق الملتزم بما فيها قيمة الضريبة على القيمة المضافة في حال توجبها.

يسدد الملتزم رسم الطابع المالي البالغ /4/ بالألف خلال خمسة أيام عمل من تاريخ ابلاغ الملتزم تصديق الصفقة، و/4/ بالألف عند تصديد قيمة العقد.

16- ضمان العرض:

حددت قيمة ضمان العرض لإشتراك العارض بالإلتزام بـ /3.250.000.000/ل.ل. ثلاثة مليارات ومئتان وخمسون مليون ليرة لبنانية.

يمكن أن يُدفع هذا الضمان نقداً او بموجب شيك مصرفي إلى صندوق المؤسسة لقاء إيصال مالي أو أن يقدم بموجب كتاب ضمان مصرفي صادر عن مصرف مقبول من الحكومة اللبنانية وساري المفعول لفترة لا تقل عن 90 يوماً إعتباراً من التاريخ المحدد لفض العروض على أن يذكر عليه أنه يتجدد حكماً إذا لم تبد المؤسسة موافقتها على إلغائه.

يعاد ضمان العرض للعارضين الراغبين الذين لم يرسُ الإلتزام عليهم فور انتهاء جلسة فض العروض. أما العارض الذي رسى الإلتزام عليه فيعاد له ضمان العرض بعد تقديمه ضمان حسن التنفيذ.

17- قواعد قبول العرض الفائز:

1- تقبل المؤسسة العرض المقدّم الفائز ما لم:

أ- تُسقط أهليّة العارض الذي قدّم العرض الفائز وذلك بمقتضى المادة 7 من قانون الشراء العام؛ أو

ب- يُلغ الشراء بمقتضى الفقرة 1 من المادة 25 من قانون الشراء العام؛ أو

ج- يُرفض العرض الفائز عند اعتباره منخفضاً انخفاضاً غير عادي بمقتضى المادة 27 من قانون الشراء العام؛ أو

د- يُستبعد العارض الذي قدّم العرض الفائز من إجراءات التلزيم للأسباب المبيّنة في المادة 8 قانون الشراء العام.

2- بعد التأكّد من العرض الفائز تُبلغ المؤسسة العارض الذي قدّم ذلك العرض، كما تنشر بالتزامن قرارها بشأن قبول العرض الفائز (التلزيم المؤقت) والذي يدخل حيّز التنفيذ عند انتهاء فترة التجميد البالغة عشرة أيام عمل تبدأ من تاريخ النشر، الذي يجب أن يتضمّن على الأقل، المعلومات التالية:

أ- إسم وعنوان العارض الذي قدّم العرض الفائز (الملتزم المؤقت).

ب-قيمة العرض، ويمكن إضافة ملخص لسائر خصائص العرض الفائز ومزاياه النسبية إذا كان العرض الفائز قد تم تأكيده على أساس السعر ومعايير أخرى،

ج- مدة فترة التجميد بحسب هذه الفقرة،

3- فور انقضاء فترة التجميد، تقوم المؤسسة بإبلاغ الملتزم المؤقت بوجوب توقيع العقد خلال مهلة لا تتعدّى //15// خمسة عشر يوماً.

4- يوقع المدير العام العقد خلال مهلة //15// خمسة عشر يوماً من تاريخ توقيع العقد من قبل الملتزم المؤقت. يمكن أن تُمدّد هذه المهلة إلى //30// ثلاثين يوماً في حالات معيّنة تحدّد من قبل المدير العام.

5- يبدأ نفاذ العقد عندما يوقّع الملتزم المؤقت والمدير العام.

6- لا تتّخذ سلطة التعاقد ولا الملتزم المؤقّت أيّ إجراء يتعارض مع بدء نفاذ العقد أو مع تنفيذ الشراء خلال الفترة الزمنيّة الواقعة ما بين تبليغ العارض المعني بالتلزيم المؤقت وتاريخ بدء نفاذ العقد.

7- في حال تمنّع الملتزم المؤقت عن توقيع العقد، تُصادر المؤسسة ضمان عرضه. في هذه الحالة يمكن للمؤسسة أن تُلغي الشراء أو أن تختار العرض الأفضل من بين العروض الأخرى الفائزة وفقاً للمعايير والاجراءات المحدّدة في قانون الشراء العام وفي ملفات التلزيم، والتي لا تزال صلاحيتها سارية المفعول. تُطبّق أحكام هذه المادة على هذا العرض بعد إجراء التعديلات اللازمة.

18- قواعد بشأن العروض المنخفضة الأسعار إنخفاضاً غير عادياً:

يجوز للمؤسسة أن ترفض أيّ عرض إذا قرّرت أنّ السعر، مقترناً بسائر العناصر المكوّنة لذلك العرض المقدّم، منخفض انخفاضاً غير عادي قياساً إلى موضوع الشراء وقيمته التقديرية وتُطبّق أحكام المادة 27 من قانون الشراء العام في هذا الشأن.

19- إلغاء الشراء او أي من اجراءاته:

يمكن للجهة الشارية أن تُلغي الشراء و/ أو أيّ من إجراءاته في أيّ وقت قبل إبلاغ الملتزم المؤقت إبرام العقد، وذلك في الحالات التي نصّت عليها المادة 25 من قانون الشراء العام.

20- ضمان حسن التنفيذ:

1- تحدد قيمة ضمان حسن التنفيذ بنسبة 10% من قيمة العقد.

2- يجب تقديم ضمان حسن التنفيذ خلال فترة لا تتجاوز //15// خمسة عشر يوماً من تاريخ توقيع العقد. وفي حال التخلّف عن تقديم ضمان حسن التنفيذ، يُصادر ضمان العرض.

3- يبقى ضمان حسن التنفيذ مجمّداً طوال مدة التلزيم، ويُحسم منه مباشرةً وبدون سابق إنذار ما قد يترتب من غرامات أو مخالفات او عطل أو ضرر يحدثه الملتزم إلى حين إيفائه بكامل الموجبات.

4- يعاد ضمان حسن التنفيذ الى الملتزم بعد انتهاء مدة التلزيم واتمام الإستلام النهائي الذي يجري بعد تأكد الإدارة من أن التلزيم جرى وفقاً للأصول.

5- يكون ضمان حسن التنفيذ إمّا نقدياً او شيك مصرفي يُدفع إلى صندوق المؤسسة، وإما بموجب كتاب ضمان مصرفي غير قابل للرجوع عنه، صادر عن مصرف مقبول من مصرف لبنان يُبيّن أنه قابل للدفع عند الطلب، ويقدم ضمان العرض باسم (المشروع) لصالح المؤسسة.

21- محل إقامة المتعاقد:

- يجب أن يتضمن العرض إتخاذ العارض محل إقامة مختاراً ضمن نطاق مؤسسة مياه بيروت وجبل لبنان ورقم هاتف و/او رقم الفاكس و/او البريد الالكتروني تبلغ إليه جميع المراسلات العائدة للإلتزام.

- إذا لم يبيّن المتعاقد في عرضه محل إقامته بصورة واضحة، تلصق جميع التبليغات على لوحة الإعلانات في المدخل الرئيسي للمؤسسة وتعتبر هذه التبليغات قانونية وملزمة له.

- إذا تغيّب المتعاقد عن محل إقامته أو تمنع عن التبلغ بتوقيعه أصل النسخة المراد تبليغه إياها، يعتبر المتعاقد مبلغاً بواسطة بريده الالكتروني او تلصق وثيقة التبليغ على باب إقامته وعلى لوحة الإعلانات في المدخل الرئيسي للمؤسسة ويعتبر هذا التبليغ قانونياً وملزماً له.

- تنظم الإدارة المختصة في حال التبليغ بطريقة اللصق محضراً يحدد فيه تاريخ وساعة تعليق وثيقة التبليغ وتضم إلى الملف.

- على المتعاقد إعلام المؤسسة رسمياً بكل تغيير قد يطرأ على مكان إقامته أو بريده الالكتروني.

22- الضرائب / الرسوم / الجمارك:

كل المصاريف العائدة لدفع الضرائب والرسوم والجمارك والنقل والتفريغ والتأمين إلخ ... هي على عاتق المتعاقد وتعتبر مغطاة بأسعار العرض.

23- منع التنازل أو التلزيم لمتعهد آخر بدون إذن التعاقد الثانوي:

لا يمكن للمتعاقد التنازل عن كل الالتزام أو جزء منه إلى فريق ثالث، ولا تلزيم جزء أو أجزاء من التزامه إلا إذا طلب ذلك خطياً من المؤسسة وحصل على موافقتها الخطية، وعدم تجاوز الجزء أو الأجزاء 50% من قيمة العقد.

في كل الأحوال يظل المتعاقد مسؤولاً شخصياً سواء تجاه المؤسسة أو تجاه الأشخاص أو أي فريق ثالث. يعتبر عملاً ملزماً إلى فريق ثالث كل عمل مسلّم إلى أشخاص غير مسجلين نظامياً في سجلات الإستخدام والدفع لدى المتعاقد.

24- براءات الإختراع:

على المتعاقد، عند تنفيذ الالتزام، الإمتناع عن إستعمال أي طريقة أو رسم أو تصميم حائز على براءة إختراع دون إذن مسبق من أصحاب الحقوق على هذه البراءة، وكل حقوق ومستحقات قد تنجم عن مثل هذا الإستعمال تكون كلياً على مسؤولية المتعاقد ونفقته. كما تحتفظ المؤسسة بحق مطالبة المتعاقد بالتعويضات الناتجة عن عدم تقيده بالتدابير المشار إليها أعلاه خاصة في حال ضبطه متلبساً بالمخالفة. على المتعاقد بالإضافة إلى ذلك، تحمل مسؤولية كل مطالبة أو عمل موجه ضد المؤسسة بهذا الخصوص.

25- حالات القوة القاهرة:

تدرس المؤسسة فقط حالات القوة القاهرة التي يعلمها بها المتعاقد خلال مهلة 10 أيام على الأكثر من حصولها وفي هذه الحالة لا يُعطى المتعاقد إلا ما توافق عليه المؤسسة. لن تقبل أية مطالبة بشأن حالة قاهرة إذا مرت أكثر من عشرة أيام على حصول هذه الحالة.

26- قوانين وأنظمة:

على المتعاقد التقيد بالقوانين والأنظمة اللبنانية النافذة في كل ما له علاقة بالشراء، وعليه أن يحصل مباشرة على التراخيص اللازمة من أجل تأمين المواد أو إستعمال لوازم معينة كل ذلك على عهدته وحسابه ومسؤوليته.

27- أشغال غير ملحوظة:

عندما تتبين ضرورة تنفيذ أشغال ضمن نطاق الالتزام لم تكن ملحوظة في الأصل أو عندما يتعين تغيير مصدر المواد المحدد أساساً في الالتزام، على المتعاقد التقيد الفوري بمذكرات العمل الخطية التي يتلقاها في المؤسسة بهذا الشأن ويعمد دون تأخير إلى تحضير أسعار جديدة.تحدد الأسعار الجديدة بالمقارنة مع الأشغال الأكثر تشابهاً. وفي حال التعذر المطلق للقيام بمثل هذه المقارنة، تؤخذ الأسعار الرائجة في البلد. تحسب الأسعار الجديدة وتناقش بين منتدب المؤسسة والمتعاقد. تخضع الأسعار الجديدة لموافقة المدير العام للمؤسسة. ويبقى

المدير العام للمؤسسة وحده صاحب الحق المطلق بإدخال التعديلات وبقضية تمديد المهلة الأساسية ليتمكن المتعاقد من تنفيذ الالتزام.

28- تغيير في الكميات:

إن الكميات في تقدير الكميات" موضوعة على سبيل الذكر فقط، ويمكن للمؤسسة بموافقة المدير العام تجاوزها زيادة أو نقصاناً دون أن يحق للمتعاقد بأية مطالبة أو تعويض او إعتراض، على ان لا تتعدى النسبة 15 % من قيمة الالتزام الاجمالية.

29- أسباب إنتهاء العقد ونتائجه:

اولاً: النكول

يُعتبر الملتزم ناكلاً إذا خالف شروط تنفيذ العقد أو أحكام نفتر الشروط هذا، وبعد إنذاره رسمياً بوجوب التقيّد بكافّة موجباته من قبل المؤسسة، وذلك ضمن مهلة تتراوح بين خمسة أيام كحدّ أدنى وخمسة عشر يوماً كحدّ أقصى، وانقضاء المهلة هذه دون أن يقوم الملتزم بما طُلب إليه. وإذا اعتُبر الملتزم ناكلاً، يُفسخ العقد حكماً دون الحاجة إلى أي إنذار وتطبيق الإجراءات المنصوص عليها في البند (أولاً) من الفقرة الرابعة من المادة 33 من قانون الشراء العام.

ثانياً: الانتهاء

1- ينتهي العقد حكماً دون الحاجة إلى أي إنذار في الحالتين التاليتين:

أ- عند وفاة الملتزم إذا كان شخصاً طبيعياً، إلاّ إذا وافقت المؤسسة على طلب مواصلة التنفيذ من قبل الورثة.

ب- إذا أصبح الملتزم مفلساً او معسراً أو حُلّت الشركة، تُطبّق عندئذ الإجراءات المنصوص عليها في الفقرة الثانية من البند الرابع من المادة 33 من قانون الشراء العام.

2- يجوز للمؤسسة إنهاء العقد إذا تعذّر على الملتزم القيام بأيّ من إلتزاماته التعاقدية بنتيجة القوة القاهرة.

ثالثاً: الفسخ

1- يُفسخ العقد حكماً دون الحاجة إلى اي إنذار في أيّ من الحالات التالية:

أ- إذا صدّر بحق الملتزم حكم نهائيّ بارتكاب أيّ جرم من جرائم الفساد أو التواطؤ أو الإحتيال أو الخش أو تبييض الأموال أو تمويل الإرهاب أو تضارب المصالح او التزوير أو الإفلاس الإحتيالي، وفقاً للقوانين المرعية الاجراء؛

ب- إذا تحقّقت أيّ حالة من الحالات المذكورة في المادة 8 من قانون الشراء العام.

ت- في حال فُقدان أهلية الملتزم.

2- إذا فُسخ العقد لأحد الأسباب المذكورة في الفقرة الأولى من هذا البند تُطبّق الإجراءات المنصوص عليها في الفقرة الأولى من البند الرابع من هذه المادة.

رابعاً: نتائج انتهاء العقد

1- في حال تطبيق إحدى حالات النكول أو الفسخ المحدّدة في المادة 33 من قانون الشراء العام، أو في حال تحقّقت حالة إفلاس الملتزم أو إعساره، أو في حال وفاة الملتزم وعدم متابعة التنفيذ من قبل الورثة، تُتبع فوراً، خلافاً لأيّ نص آخر أحكام الفقرة رابعاً من المادة 33 من قانون الشراء العام.

2- لا يترتّب أيّ تعويض عن الخدمات المُقدّمة أو الأشغال المنفّذة من قبل من يثبت قيامه بأيّ من الجرائم المنصوص عليها في الفقرة الفرعية "أ" من الفقرة الأولى من «ثالثاً» من المادة 33 من قانون الشراء العام.

3- يُنشر قرار انتهاء العقد وأسبابه على الموقع الالكتروني للمؤسسة إن وُجد وعلى المنصة الإلكترونية المركزية لدى هيئة الشراء العام.

30- الاقتطاع من الضمان:

إذا ترتّب على الملتزم في سياق التنفيذ مبلغ ما، تطبيقاً لأحكام وشروط العقد، حق للمؤسسة اقتطاع هذا المبلغ من ضمان حسن التنفيذ ودعوة الملتزم إلى إكمال المبلغ ضمن مدّة معيّنة، فإذا لم يفعل اعتُبر ناكلاً وفقاً لأحكام الفقرة (أولاً) من المادة 33 من قانون الشراء العام.

31- القضاء الصالح:

كل نزاع أو خلاف عائد للالتزام يحدث بين المؤسسة من جهة والمتعاقد من جهة أخرى سواء أثناء التنفيذ أو بعد الإنتهاء منه وسواء قبل أو بعد إلغاء أو نكث أو توقف عن تكملة الالتزام، يفصل به أمام المحاكم اللبنانية المختصة.

في حال حصول أي خلاف لا يجوز للمتعاقد توقيف الأشغال الجارية أو اللاحقة لأي سبب كان تحت طائلة تطبيق التدابير المنصوص عنها في المادة /26/ من دفتر الشروط مع إحتفاظ المؤسسة بحق فرض جزاء التأخير عند الإقتضاء.

32- الإقصاء:

تطبق أحكام الإقصاء على الملتزم الذي يعتبر ناكلاً أو الذي يصدر بحقه حكم قضائي وفقاً لما نصت عليه المادة 40 من قانون الشراء العام.

33- النزاهة:

تُطبّق أحكام المادة 110 من قانون الشراء العام.

34- الشكوى والاعتراض:

يحق لكلّ ذي صفة ومصلحة، بما في ذلك هيئة الشراء العام، الإعتراض على أيّ إجراء أو قرار صريح أو ضمني تتّخذه أو تعتمده أو تطبّقه أي من الجهات المعنيّة بالشراء في المرحلة السابقة لنفاذ العقد، ويكون مخالفاً لأحكام قانون الشراء العام والمبادئ العامة المتعلقة بالشراء العام، وتُطبق أحكام الفصل السابع من قانون الشراء العام في هذا الشأن، على ان تتبع إجراءات الإعتراض المعمول بها لدى مجلس شورى الدولة لحين تشكيل هيئة الإعتراضات المنصوص عنها في قانون الشراء العام.

35- تحفظات المتعاقد:

على المتعاقد ان يقدم جميع تحفظاته واعتراضاته التي يترتب عنها دفع أي مبلغ مرفقة بتبرير المبالغ المضبوطة أو المفصلة والمعللة التي يطالب بها وذلك تحت طائلة رد طلبه وفقدان حقه. كما عليه أن يرفق مع تحفظه بشأن التأخير أو تمديد المهلة الأسباب الموجبة بالتفصيل مع اثبات الوقائع التي أدت إلى ذلك مع بيان مدة التمديد المطلوبة تحت طائلة فقدان حقه بها.

36- التقيّد بجدول الاسعار:

ان الأسعار الافرادية المدونة والمفقطة او التنزيل المئوي المدون والمفقط في جدول الأسعار هي التي يعول عليها، وفي حال وجود تناقض بين مستندات الالتزام فان نص جدول الأسعار يعتبر وحده صحيحاً ويقتضي الرجوع اليه للوقوف على تفاصيل ومواصفات الأشغال المطلوبة، مع العلم أنه يعول على النسخة الأساسية لكل مستندات الالتزام دون بقية النسخ.

37- رفع السرية المصرفية:

ان يُعتبر العارض فور تقديمه العرض ملتزمًا برفع السرية المصرفية عن الحساب المصرفي الذي يودع فيه أو ينتقل إليه أي مبلغ من المال العام المتعلق بهذا التلزيم، سنداً للقرار رقم 17 تاريخ 2020/5/12 الصادر عن مجلس الوزراء.

38- دفع المبالغ المتوجبة:

تحسب المبالغ المتوجبة تبعاً للكميات المنفذة فعلياً ووفقاً للقياسات الناتجة عن الكيل شرط أن تكون هذه الأشغال مطابقة لموجبات الصفقة وشروطها.

لا يجوز الشروع في عمل يحجب عملاً آخر تمّ، ما لم يكن المهندس قد تحقق من قياساته وأبعاد الأشغال السابقة ومناسيبها بحضور المتعاقد أو مندوبه وتأكد من تدوينها في دفتر الكيول.

يقدم المتعاقد إستناداً إلى تقارير كيل الكميات المنفذة كشوفات تتضمن بيان الكميات الأساسية للصفقة والكميات المنفذة تباعاً، وقيمتها. يجري الدفع بموجب هذا الكشف بعد أخذ الموافقات اللازمة عليه وبعد حسم التوقيفات المحددة في المادة "التوقيفات العشرية" اللاحقة.

يقدم المتعاقد كشف حساب عاماً ونهائياً يرفق بكشوفات الكميات والمستندات اللازمة.

في حال وجود إعتراضات على قيمة كشف الحساب العام والنهائي، يصرف فقط المبلغ المقبول من المؤسسة، طالما لم تجر تسوية بشأن هذه الإعتراضات بين المؤسسة والمتعاقد.

إن جميع المعاملات المالية والمدفوعات تنظم بالعملة اللبنانية.

39- التوقيفات العشرية:

عند كل دفع، يجري على سبيل الضمان توقيف 10% (عشرة بالمئة) من القيمة المستحقة. يظل هذا التوقيف مربوطاً بضمان الإرتباطات المتعاقد عليها حتى الإستلام النهائي.

40- غرامة التأخير:

يخضع المتعاقد لغرامة تأخير تساوي واحد بالألف من قيمة العقد عن كل يوم تأخير بعد إنتهاء المهلة التعاقدية. غير أنه لا يمكن للمجموع الإجمالي لغرامة التأخير أن يتجاوز عشر القيمة الإجمالية للعقد.

تعتبر مدة الصفقة نهائية ويدخل ضمنها أيام الآحاد والأعياد والعطل، كذلك يدخل ضمنها التأخير الناتج عن الأمطار والرياح والزوابع وتغيرات الطقس والعراقيل من أي نوع كانت وكل ما هنالك من إستعدادات وتحضيرات لحسن سير العمل.

يبقى المدير العام للمؤسسة صاحب السلطة والرأي الأخير في ما يعود لتمديد مهلة التنفيذ ولإعفاء الملتزم من غرامات التأخير أو قسم منها.

41- الاستلام المؤقت:

بعد انتهاء مدة الصفقة يطلب المتعاقد استلاماً مؤقتاً، عندها يعمد إلى هذا الاستلام من قبل المؤسسة بحضور المتعاقد، في حال غياب المتعاقد يذكر ذلك في المحضر.

على المتعاقد ان يعلم المؤسسة عن التاريخ الذي تنتهي به الأعمال المطلوبة منه في هذه الصفقة والذي يكون به على استعداد لتسليم الأشغال إلى المؤسسة تسليماً مؤقتاً، وذلك قبل اسبوع واحد على أقل تعديل من ذلك التاريخ، وذلك بموجب كتاب يوجهه إلى المؤسسة ويوافق عليه المهندس. ويحق للمؤسسة إذا وجدت في الأعمال والمواد الجاري تسليمها اي نقص أو عيب أو مخالفة لشروط الصفقة ان ترفض استلامها أو ان تطلب إلى المتعاقد استكمال تلك النواقص وتصليح تلك العيوب وإزالة تلك المخالفات قبل اعتبار الاستلام المؤقت ممكناً. وإذا كانت تلك النواقص والعيوب والمخالفات الملحوظة من النوع المحدود، أو التي يمكن تصليحها بسهولة نسبية فبإمكان المؤسسة استلام الأعمال المنجزة أو إي جزء منها استلاماً مؤقتاً وتسجيل النواقص والعيوب والمخالفات في تحفظ

خاص ليجري اما استكمالها وانجازها من قبل المتعاقد خلال مدة تحدد له أو حسم مبلغ من استحقاقه مساو حسب تقدير المؤسسة لتلك العيوب والنواقص لتستكملها المؤسسة فيما بعد وفي الوقت الذي تراه مناسباً.

ان كل تأخير من قبل المتعاقد في تقديم هذا الملف النهائي يؤدي إلى تأخير مماثل في تنظيم محضر الاستلام المؤقت والكشف النهائي ومحاسبة المتعاقد إذ لا تعتبر الأشغال قابلة للاستلام ما لم يقدم الملف المذكور.

42- مهلة الضمان:

حددت مهلة الضمان بثلاثة أشهر اعتباراً من الاستلام المؤقت لهذا الالتزام.

على المتعاقد، خلال فترة الضمان، ان يصون كل الأشغال التي قام بتنفيذها على اكمل وجه وحتى يوم الاستلام النهائي. عليه ان يعمد فوراً إلى تصليح كل شائبة قد تظهر على أي جزء من الأشغال وتصليح ورفع كل عطل وضرر ناتج عن أشغاله ويلحق بأملاك الغير حتى تاريخ الاستلام النهائي وعليه ان يبادر إلى إجراء التصليحات فور اخطاره بذلك ضمن مهلة أقصاها عشرة ايام تبدأ من تاريخ تبلغه الأخطار. فإذا انقضت هذه المهلة ولم يبادر إلى إجراء التصليحات اللازمة حق للمؤسسة ان تقوم باجرائها على عاتق الملتزم ومسؤوليته بالطرق التي تراها مناسبة، دون ان يحق له الاعتراض. وتقتطع أكلاف هذه العملية من توقيفات أو ضمانات الملتزم أو بواسطة التحصيل القانوني إذا فاقت هذه التوقيفات أو الضمانات، من جهة أخرى وحتى بعد الاستلام النهائي.

برفض الاستلام النهائي إذا لم تنفذ كل التصليحات المطلوبة بموجب طلبات أو مذكرات تبلغها الملتزم.

43- الاستلام النهائي:

مع طلب إجراء الاستلام النهائي للأشغال يقدم المتعاقد إلى المؤسسة ملفاً من نسخة واحدة على ورق ونسخة على قرص مدمج يشمل كل خرائط التنفيذ (As Built Drawings). ترفض هذه الخرائط ويعاد تنظيمها من قبل المتعاقد إذا ظهرت فيها أخطاء أو نواقص.

يجري الاستلام النهائي بعد نهاية مهلة الضمان التي تلي الاستلام المؤقت. على المتعاقد أخطار المؤسسة خطياً بالتاريخ الممكن اجراءه فيه. تعمد المؤسسة إلى إجراء الاستلام النهائي بعد التأكد من عدم وجود أي عيوب أو نواقص في التنفيذ.

44- إعادة التأمينات:

تعاد التوقيفات العشرية وضمان حسن التنفيذ إلى المتعاقد خلال شهر على الأكثر من تاريخ الاستلام النهائي وبعد أن يكون قد قام بجميع إلتزاماته.

45- جمع المعلومات عن شروط الأشغال:

إن للمعلومات الفنية والإرشادات المعطاة في مستندات الصفقة صفة توجيهية عامة، وعلى المتعاقد مراجعتها والتدقيق فيها بوسائله الخاصة وعلى مسؤوليته.

لن يحق للمتعاقد رفع أية مطالبة بسبب نقص في المعلومات.

46- ممثل المؤسسة:

تحتفظ المؤسسة بحق تسمية مهندس تكون له صفة اعطاء أو نقل مذكرات العمل إلى المتعاقد.

ان مراقبة تنفيذ الأشغال من قبل المهندس أو من مندوبه لا تنقص مسؤولية المتعاقد في تأدية التزاماته كاملة بأمانة ودقة واتقان.

47- مذكرات العمل:

يمكن للمتعاقد خلال فترة التنفيذ ان يتلقى من المهندس مذكرات عمل خطية، وعليه أن يتقيد بها بدقة.

عندما يقدر المتعاقد بأن تعليمات مذكرة عمل تفوق موجبات عقده، عليه تحت طائلة الاسقاط، تقديم ملاحظاته الخطية المبررة بشأن هذه التعليمات خلال مهلة 10 أيام.

الاعتراض لا يوقف تنفيذ مذكرة عمل، إلا إذا أمرت المؤسسة بغير ذلك.

48- أشغال الليل:

يحق للمؤسسة الطلب إلى الملتزم تنفيذ أشغال عائدة إلى جزء أو بعض أجزاء من الورشة أثناء الليل وذلك لعدم عرقلة السير أو لأية أسباب أخرى تراها ضرورية ولا يحق للملتزم بأية مطالبة أو تعويض.

49- عقود التأمين:

على المتعاقد، قبل بدء التنفيذ وعلى نفقته، أن يعقد تأميناً ضد حوادث العمل لعماله وموظفي المؤسسة الموجودين على الورشة، والآليات والحوادث المسببة للغير عند شركة تأمين مسجلة وفقاً للأصول.

تخضع قيمة عقود التأمين وشروط تطبيقها لموافقة المدير العام للمؤسسة دون أن يعفي ذلك المتعاقد من مسؤوليته الكاملة.

يجب ان يظل التأمين ضد حوادث العمل قائماً طيلة فترة العمل في الورشة. يعتبر واجب المتعاقد بعقد التأمين مطبقاً في حال سمحت المؤسسة للمتعاقد بتلزيم صفقته لفريق ثالث وقام هذا الفريق بعقد التأمين. على المتعاقد تقديم البوليصة أو البوالص ومخالصات الأقساط للمؤسسة.

TECHNICAL SPECIFICATIONS
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Part I: General

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PART 1 - GENERAL

1-A ABBREVIATIONS

Wherever the following abbreviations are used in the specifications or in the plans, they are to be constructed the same as the respective expressions represented:

AC	Asbestos Cement
AASHTO	American Association of State Highway and Transportation Officials
AAMA	Architectural Aluminum Manufacturer's Association
ACI	American Concrete Institute
AFNOR	Association Française de Normalisation ANSI
	American National Standards Institute ASME
	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AISC	American Institute of Steel Construction AISI
	American Iron and Steel Institute
AWWA	American Water Works Association
AWS	American Welding Society
BS	British Standard
CDR	Council for Development and Reconstruction CP
	Code of Practice
DIN	Deutscher Normausschuss
DTU	Documents Techniques Unifiés
EDL	Electricity of Lebanon
FSS	Federal Specifications and Standards (United States) gpm
	gallons per minute
GRP	Glass Reinforced Plastic
IEC	International Electrotechnical Commission ISO
	International Standards Organization
ITS	Institute of Technical Studies
m	meters
mm	millimeters
m^2	square meter
m^3	cubic meter
NEMA	National Electrical Manufacturers Association
NF	Normes Françaises
UTE	Union Technique de l'Electricité
VDE	Verband Deutscher Electrotechniker

1-B GENERAL

1-B-1 STANDARDS

1- All references to codes, specifications and standards referred to in the Contract Documents shall mean, and are intended to be, the latest edition, amendment or revision of such reference standards in effect.

2- Whenever the Contract Documents require that a product complies with certain Standards or Specifications, the Contractor shall present a certificate from the manufacturer ensuring that the product complies therewith. Where requested or specified, the Contractor shall submit supporting test data to substantiate compliance.

Each and every part of the works shall be designed, constructed, manufactured, tested and installed in accordance with an internationally recognized Standard, Code of Practice, or Regulation applicable to that part of the works. The Technical Specifications could refer to one or more standards, but it is still accepted that any international recognized standard, code of practice or regulation could be applicable with the prior consent of the Engineer.

If any clarification or additional information regarding technical aspects, the Contractor must submit a request for information.

1-B-2 EQUIVALENCY OF STANDARDS AND CODES

Wherever reference is made in the Contract including the Specifications, Drawings and Bill of Quantities to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract.

Where such standards and codes are national or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards and codes specified will be accepted subject to the Engineer's prior review and written consent. Differences between the standards specified and the proposed alternative standards shall be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's consent.

In the event the Engineer determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the Contract.

1-B-3 SILENCE OF SPECIFICATIONS

The apparent silence of the specifications, plans or other Contract Documents as to any detail or the apparent omission from them of a detailed description concerning any point, shall be regarded as meaning that only the best general practice is to be used. All interpretations of the specifications will be made by the Engineer on this basis.

1-B-4 LANGUAGE OF CORRESPONDENCE AND RECORDS

All communications from the Contractor to the Engineer shall be in the Arabic or English language. All books, time sheets, records, notes, drawings, documents, specifications and manufacturers' literature etc. shall be in the Arabic or English language.

1-B-5 UNITS

The International System of (metric) Units shall be used throughout the Contract except where otherwise provided.

1-B-6 INTENTION OF TERMS

Where "as shown", "as indicated", "as detailed" or words of similar import are used, it shall be understood that reference to the drawings accompanying the Specifications is made unless otherwise stated. Where "as approved", "as directed", "as required", "as accepted", or words of similar import are used, it shall be understood that the approval, direction, requirement, permission, authorization, review, or acceptance of the Engineer is intended, unless otherwise stated. "Provide" shall be understood to mean "complete in place", that is, "furnish and install".

Whenever anything is, or is to be done, if, as, or, when, or where "contemplated, required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered, considered necessary, deemed necessary, permitted reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected or condemned", it shall be understood as if the expression were followed by the words "by the Engineer" or "to the Engineer".

The phrases "or equal" and "or equivalent" shall be construed to mean that material or equipment will be acceptable only when composed of parts of equal quality, or equal workmanship and finish, designed and constructed to perform or accomplish the desired result as efficiently as the named brand, pattern, grade, class, make or model.

1-B-7 INTENT OF CONTRACT

The intent of the Contract is to provide for the construction and completion in every detail of the works described. The Contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work in accordance with the plans, specifications and terms of the Contract Documents.

Unless otherwise specified, the Contractor shall allow a minimum of 21 days for approval of drawings and documents by the Engineer.

1-B-8 BILLS OF QUANTITIES

Detailed Bills of Quantities shall be prepared by the Contractor in accordance with the measurement rules described in the preamble and as approved by the Engineer.

1-B-9 OPERATION AND MAINTENANCE MANUALS

The Contractor shall submit to the Engineer for approval draft copies of the Operation and Maintenance Manuals. A separate set of instructions shall be provided for each installation. The Contractor shall incorporate any amendments or additions required by the Engineer in the production of the final Manuals.
The draft O & M Manuals shall be available on site at all times during Tests on Completion for the instructions to be verified. Any modifications found necessary shall be incorporated in the final version.

The Contractor shall supply the final version of the Operation and Maintenance Manuals prior to the issue of the Taking Over Certificate for either the whole of the works or the respective section or part of the works.

The Contractor shall, as necessary, carry out survey work, take measurements, collect details, produce drawings and undertake all other work required to enable him to prepare the manuals.

Operation and Maintenance Manuals shall be supplied written in the English and Arabic languages, and all parts and equipment listings shall be in English.

1-B-10 WORK THROUGH PRIVATE PROPERTY

In order that the necessary easements may be obtained and /or the owners of private property may be served with the requisite notices it shall be an obligation of the Contractor to supply the Engineer from time to time with full information of his program sufficiently in advance of the dates upon which the Contractor will wish to enter upon each parcel of private land.

The Contractor shall consult with Owners and Tenants (if any) and have written approval before entering on their land or cutting through any ditch, bank, hedge, wall, fence or any other form of boundary marking and he shall ascertain and carry out their reasonable requirements as approved by the Engineer in the matter of reinstatement.

1-B-11 PUBLIC UTILITY MAINS AND SERVICES, LOCATING, ETC

It shall be the responsibility of the Contractor to obtain all information available from the Public Utility Authorities regarding the position of mains and services and he shall make this information available to the Engineer as soon as he obtains it.
The absence of such information shall not relieve the Contractor of his liability for the cost of any repair work necessitated by damage caused by him to any mains or services in the course of his work and for the cost of all losses arising from the disruption.
All locating work shall be carried out in advance of further excavation work. The Contractor shall obtain all information and assistance available from the Public Utility Authorities for the locating of the mains and services and shall agree with the Engineer any trial excavation which may be necessary to confirm or establish these locations.
Any temporary or permanent diversion of mains and services will only be permitted after agreement with the appropriate Public Utility Authority.

1-B-12 PROJECT CONTROL

1- The Contractor shall provide within his site organization a project management section to advise and be directly responsible to the Contractor's Engineer. The duties of the section shall include the following:

i. Planning and program preparation particularly in relation to the requirements of public authorities and the requirements to maintain water supply disposal services where careful detailed arrangements have to be made and adhered to.
ii. Planning the execution of the works in a manner which minimizes disruption to the water supply and wastewater systems and will permit the efficient and effective commissioning of the water supply and wastewater systems and its respective components.
iii. Ensuring adequate water supplies are maintained to all consumers. Also, ensuring all existing wastewater systems are functionning during execution.
iv. Continuous surveillance of progress and anticipation of factors likely to affect the timely performance of the Contract.
v. Making proposal for modification to forward planning and to the program at an early stage in the light of factors resulting from (iv).
vi. Continuous appraisal of the Contractor's methods and routines particularly as to their effectiveness relating to speed of execution and to their effect on the community and property.

vii. Forward planning for resource requirements taking due account of possible shortages and delays in the arrival on site of materials, plant, personnel, etc. and their mobilization for effective usage.

viii. Acquisition and process of up-to-date information for progress meetings with the Engineer. The preparation of monthly progress reports including an update of the detailed program and cash flow forecast.

2- The project management section shall be in the charge of a professionally qualified engineer specializing in project management having had at least 10-year experience on similar projects and being versed in modern management techniques. Supporting staff for this section shall be in adequate numbers to carry out their duties and shall be of adequate ability and experience to the Engineer's approval.

3- Programs shall be based upon C.P.M. networks in precedence format and shall be prepared using a suitable P.C. - based project management software package approved by the Engineer.

4- Reporting shall be in a manner compatible with the Employer's or Engineer's requirements.

1-B-13 QUALITY CONTROL

The Contractor shall be responsible for his own quality control and shall provide sufficient competent personnel for supervising the Works, taking and preparing samples and for carrying out all necessary tests.

1-B-14 MONTHLY CERTIFICATES

Monthly certificates shall be submitted in an approved manner and format. The certificate shall detail the measured value of the work completed on each item of the Works. An item shall constitute a single structure or a component of a system such as a single pipeline or valve complex.

1-B-15 PROGRESS MEETINGS

The Contractor shall arrange progress review meetings, to be chaired by the Engineer, at monthly intervals to coincide with submission of monthly progress submissions.

1-B-16 PROPRIETARY MATERIALS

Material shall be supplied in suitable containers and in appropriate batch sizes for the work to be undertaken.

The following information shall be marked:

i. Storage instructions;
ii. The manufacturer's name;
iii. Shelf life and dates of manufacture;
iv. Material identification;
v. Batch reference number;
vi. Net weight;
vii. Mixing instructions;
viii. Any warnings or precautions concerning the contents and their safe use.

The Contractor shall supply with each consignment of proprietary material delivered to the Site, certificates furnished by the manufacturer or his agent stating:

i. The manufacturer's name and address;

ii. The agent's name and address where applicable;

iii. Material identification;

iv. Batch reference numbers, size of each batch and the number of containers in the consignment;

v. Date of manufacture.

1-B-17 REJECTED MATERIALS

Should any materials or manufactured articles be in the judgment of the Engineer, unsound or of inferior quality or in any way unsuited for the purpose in which it is proposed to employ them, such materials or manufactured articles shall not be used upon the Works but shall be branded, if in the opinion of the Engineer this is necessary, and shall forthwith be removed from the Site.

1-B-18 QUALITY

The materials and workmanship shall be the best of their respective kinds and to the approval of the Engineer. The words "to the approval of the Engineer" shall be deemed to be included in the description of all materials and workmanship for the due execution of the Works.

1-B-19 OFFICES, TRANSPORT, EQUIPMENT AND SERVICES FOR ENGINEER

The Contractor shall provide and properly maintain, for the duration of the Work, the offices for the use of the Engineer, his staff, the Employer and the Employer's Representative. This office shall be constructed, equipped and furnished as directed by the Engineer. These facilities shall be completed and ready for occupancy within sixty (60) days from the date of signing the Contract.

The Contractor shall submit to the Engineer, for approval, details of the offices space to be constructed, equipped and furnished before construction is commenced.

The Contractor shall, at the completion of the Work, supply electricity, water and sanitary facilities for the Engineer's offices. The Contractor shall be fully responsible for the maintenance and operation, including labor and materials, for the offices.

The Contractor shall supply the Engineer with mobile telephones as necessary to enable efficient communication between the contractor and the Engineer's supervision staff.

The Contractor shall also supply the Engineer, for the duration of the work, with 4x4 wheel drive vehicles as necessary to access all different site locations. These vehicles should be powerful enough to withstand all kind of driving conditions, rough roads, natural terrains and tough weathering conditions.

1-B-20 FACILITIES FOR SURVEY AND INSPECTION BY THE ENGINEER

The Contractor shall make available technicians and such labor, materials and safety equipment as the Engineer may require for inspections and survey work in connection with the Works. The Contractor shall provide all necessary tackle, test equipment, access, labor, staff and any other thing the Engineer may reasonably require in order that he may safely, conveniently and quickly carry out such inspections as he deems necessary at any time during the execution of the Works including the Tests on completion.

1-B-21 INSPECTIONS BY THE ENGINEER DURING DEFECTS LIABILITY PERIOD

The Engineer will give the Contractor due notice of his intention to carry out any inspections during the Defects Liability Period and the Contractor shall thereupon arrange for a responsible representative to be present at the times and dates named by the Engineer. This representative shall render all necessary, assistance and record all matters and things to which his attention is directed by the Engineer.

1-B-22 APPROVAL

As soon as possible after commencement of the Contract, the Contractor shall submit to the Engineer for his approval a list of his proposed suppliers, sources of materials, construction requirements and proposed standards. No materials, plant or equipment shall be procured for the Contract without first obtaining the Engineer's approval. Samples of materials shall be submitted to the Engineer for approval as required by the Engineer. Materials subsequently supplied shall conform to the quality of the samples which have been approved by the Engineer. No standard, method of manufacture or specification shall be changed without the approval of the Engineer. Where possible plant shall be supplied to the same standards or to compatible standards.

1-B-23 PROTECTIVE CLOTHING

The Contractor shall provide for the Engineer, his Representative and assistants the protective clothing necessary for the proper discharge of their duties on Site.

The Contractor shall provide any necessary protective clothing and safety equipment for the use of authorized visitors to the site including the Employer and his staff and representatives and those of any relevant authority and who have reason to visit the Site.

1-B-24 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS

All materials, manufactured articles and machinery incorporated in the permanent works shall be new, recently manufactured and shall meet the quality requirements of the Contract. They must, in all cases, be approved by the Engineer prior to their inclusion into the work.

All shipment of materials must be accompanied by a Manufacturer's Certificate of Guarantee or test certificate from an approved independent laboratory when delivered to the site. The independent laboratory shall be approved by the Engineer before any materials are submitted for tests. However, all materials delivered to the Site are subject to additional laboratory testing when requested by the Engineer even though the materials are accompanied by a certificate of guarantee or laboratory test certificate. All costs in connection with certificates of guarantee or laboratory tests and certificates shall be borne by the Contractor. Falsification of such documents shall be just cause for rejection of the materials and all cost of transportation and handling of the rejected materials shall be the sole responsibility of the Contractor.

In order to expedite the work, the Contractor shall, before placing any purchase order for materials, manufactured articles and machinery to be part of the permanent works, submit for the approval of the Engineer, a complete description of such items, the names of the firms from whom he proposes to obtain such items, together with a list of the items he proposes each firm would supply. No materials, manufactured articles or machinery shall be ordered from any firm without the written approval of the Engineer. When directed by the Engineer or otherwise specified in the Contract, the Contractor shall submit samples for approval.
If it is found after trial that sources of supply for previously approved materials, manufactured articles, or machinery do not produce specified products, the Contractor shall furnish the items from other sources approved by the Engineer.

1-B-25 PRECAUTIONS AGAINST CONTAMINATION OF THE WORKS

The Contractor shall at all times take every possible precaution against contamination of the works.

The Site and all permanent and temporary works shall be kept in a clean, tidy and sanitary condition.

The Contractor shall at all times take measures to avoid contamination of existing water courses and drains by petrol, oil or other harmful materials.

The works shall be kept clean and free from rubbish and remedial works shall be carried out as the work is progressively completed. Before requesting inspection for preliminary or final take-over of the works or any section thereof the Contractor shall inspect the works and assure himself that they are clean and in a satisfactory condition for such inspection, normal usage expected.

1-B-26 ENVIRONMENTAL ASPECTS

The Contractor shall take all reasonable steps to minimize the adverse affects of both the temporary and permanent works on the environment. Before any work commences, the Contractor shall submit an environmental protection plan describing how potential adverse impacts will be mitigated. These adverse environmental impacts could be:

a. Pollution of soil and water due to improper dumping of excavated and construction material, oils used, chemicals/solvents, human wastes.

b. Erosion of soil, sedimentation and drainage due to excavation and bedding.

c. Noise and air (dust, odor) pollution due to operation of machinery and excavation.

d. Traffic increase due to trucks (sand, machinery, equipment) movement and traffic disturbance.

e. Disturbance to recreational, archaeological, touristic sites.

f. Public health and safety due to the operation of the machinery and accidents.

g. Damage to forests, agricultural land, vegetated area and its wildlife habitat.

1-B-27 ACCESS TO PROPERTIES

The Contractor shall not disrupt any private or public access way without first providing alternative arrangements.

Access to properties affected by the Works shall be maintained. Adequate road plates shall be provided for trench crossings.

1-B-28 CONTROL OF DUST

The Contractor shall, throughout the execution and completion of the Works take all reasonable steps to avoid damage or nuisance to persons or property resulting from dust and shall carry out preventative measures, such as spraying the ground with water, and /or soil covering, as instructed by the Engineer.

1-B-29 SAFETY

The Contractor must cover all aspects of site safety during the Works.

1-B-30 PROJECT SAFETY PLAN

Before any work commences on the Site the Contractor shall submit a Project Safety Plan *(PSP)* which shall be specific to the Contract. The plan shall detail the Contractor's site safety organization, his safety rules and procedures and methods of monitoring and enforcing his procedures.

The Project Safety Plan shall cover all aspects of site safety and shall typically include the following:

a. Health and Safety Policy and Primary Objectives:

The plan shall demonstrate that management of health and safety is an integral part of the management and co-ordination of the project.

b. Organization and Responsibilities:

A designated competent person shall be specified as the Contractor's Safety Officer with overall responsibility for the establishment, implementation and enforcement of safety procedures and methods of working.

The Contractor's organization structure and responsibilities with respect to safety shall be detailed.

c. Hazard Identification and Risk Assessment:

The Contractor shall assess the risks to workers and any others that require access to the site or the works or may be affected by the operations.

A systematic general examination of each activity and assessment is to include:

- Identification of the hazards present and those hazards their operations will introduce to the site.
- Identification of the people exposed.
- The extent of the risk evaluated after considering the existing control measures.
- Further assessments to be made for new activities.
- Plant and equipment to be identified and those responsible for its provision and maintenance to be defined and designated.
- Review and revision if assessments may no longer be valid or where there has been a significant change.
- Planned review of assessments at regular intervals.
- Inform employees on the nature of the hazard and the risks identified by the assessments, the preventative and protective measures, emergency procedures and the competent personnel.
- Significant findings of assessments to be recorded.

d. Emergency Procedures:

Effective procedures for contingency in event of serious and immediate danger. All employees shall be able to stop work and immediately proceed to a place of safety if exposed to imminent and unavoidable danger.

e. Cooperation and Coordination:

All competent persons to liaise and assist in assessing the shared risks and coordinating any necessary measures, primarily by providing information. The Contractor to take full responsibility in coordination arrangements.

f. Capabilities and Training:

Provision of health and safety training for all employees upon recruitment and on exposure to new or increased risks.

g. Monitoring:

Scheduled hierarchical audit system conducted by the Contractor. Safety performance to be monitored and measured against the PSP; project procedures for safe systems of work; and specified safety performance standards.

h. Health and Safety Performance Standards to be specified, i.e.:

- Relevant statutory legislation
- Standard specifications (BSI/ISO)
- Approved codes of practice
- Specific Project Safety Plan Information:
- Nature of the Project
  - Name of Employer
  - Location
  - Nature of construction work to be carried out
  - Time scale for completion of the construction work
- The existing environment
  - Surrounding land uses and related restrictions – e.g. premises (schools) adjacent to the proposed construction site.
  - Existing services - e.g. underground and overhead lines.
  - Existing traffic systems and restrictions.
  - Existing structures - e.g. special health problems from materials in existing structures which are being demolished or refurbished, any fragile materials which require special safety precautions, instability problems etc.
  - Ground conditions - e.g. contamination, instability, possible
  - subsidence, underground obstructions etc.
- Existing drawings
  - Available drawings of structure(s) to be demolished or incorporated in the proposed structure(s)
- The design
  - Significant hazards of work sequences.
  - The principals of the design and any precautions that might be needed or sequences of assembly that need to be followed during construction.
  - Detailed reference to specific problems with proposals for managing these problems.
- Construction materials
  - Health hazards where either because of their nature or the manner of their use, particular precautions are required.
- Site wide elements
  - Outline emergency arrangements including access and egress.
  - Positioning of site access and egress points.

- Location of temporary site accommodation.
- Location of unloading, layout and storage areas
- Traffic/pedestrian routes.

– Overlap with other undertaking

- Consideration of the health and safety issues which arise when the project is to be located in premises occupied or partially occupied by the Employer or other authority.

– Site Rules

- Specific sites rules which the client or the planning supervisor may wish to lay down as a result of points above or for other reasons - e.g. specific permit to work rules, emergency procedures.

– Continuing liaison

- Procedures for considering the health and safety implications of work elements
- Procedures for dealing with unforeseen eventualities during project execution.

1-B-31 HAZARDS

Potential hazards associated with the Sites may include, but will not be limited to the following:

– Any chamber, pipeline, borehole, excavation or other structure (whether above or below ground) not effectively ventilated.

– Compressed air vessels may burst explosively.

– Toxic Fumes and Gases: (generated by combustion engines, chlorine, ammonia, treatment processes).

– Asphyxiating Gases.

– Dangerous Fumes and Gases.

– Chemicals: Chemicals are stored and used in many processes. Most of them are strongly alkaline, acidic, toxic or otherwise aggressive.

– Electricity Cables:

Buried and overhead cables of all voltage ratings may be encountered. Overhead cables of all voltage ratings may be encountered. On operational sites the clearance may be lower than in highways or public areas. Hazards are as for buried cables, with the additional risk of arcing. Arcing may occur from the cables to metal objects or spray.

– Buried services:

Buried water pipes may be encountered on any operational site. The water may be under very high pressure.

– Moving Machinery:

Any operational plant may contain moving machinery. Much of this is automatically controlled and may start without warning.

There is electrical plant associated with such machinery, carrying the same hazards as electricity cables.

– Noise (high frequency noise)

Machinery such as engines, turbines, generators, pumps or compressors operating inside buildings may produce very loud noise. High speed machinery may produce high frequency noise. The hazards are possible short and long term hearing damage if ear defenders are not worn.

– Moving Vehicles:

Any road on an operational site may carry vehicles which are relatively heavy for the class of road. Such vehicles may carry any of the chemicals or sludge's noted above.

Tractors and other machinery may operate on unpaved areas.

– Contact Lenses:

In areas where an arc flash can occur (chambers or where welding processes are carried out) wearers of contact lenses can sustain irreparable damage to their eyes. This can occur whether or not safety spectacles are worn over the contact lenses.

– Confined Spaces

a. Provide, when work is in progress, radio or telephone communication, or safe visual and oral communication where this is appropriate and background noise levels permit.

b. Ensure that all electrical tools and equipment are of the appropriate type.

c. Provide appropriate protective clothing.

d. Provide hygiene facilities if appropriate.

e. Ensure that all persons entering or working in a confined space are trained and authorized to enter.

1-B-32 WATER AND ELECTRICITY SUPPLY

The Contractor shall make his own arrangements for procuring water and electricity supplies, at his own expense. Public water and electricity cuts shall, in no way, justify delays in the progress of the work. He shall be solely responsible for ensuring the continuity of the water and electricity supply. For this purpose, he shall install the needed number of generators and water tanks that would meet his needs.

1-B-33 SAFEGUARDS TO EXISTING PIPES, CABLES, STRUCTURES

It shall be the Contractor's responsibilities to safeguard by means of temporary or permanent supports or otherwise all existing pipes, cables, structures or other things which would be liable to suffer damage if such precautionnary measures were not taken.

Temporary safeguards shall be to the approval of the Engineer and of the Undertaker or Owner concerned.

Permanent safeguards shall be to the approval of the Undertaker or Owner concerned and the Engineer.

1-B-34 CONNECTIONS TO EXISTING PIPES, CABLES ETC.

The Contractor will be responsible for connections between pipes, cables etc. laid by him and existing pipes, cables etc. The Contractor shall submit to the Engineer a drawing showing the details of the connection, and shall state the date on which the particular connection could be made. The work shall not proceed until the Engineer's approval has been given.

The Contractor shall be responsible for joining up to and ensuring complete compatibility with existing pipework, cables, tubing, equipment etc.

1-B-35 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTIES

At points where the Contractor's operations are adjacent to properties of telegraph, telephone and power agencies or companies, or adjacent to other property, damage to which might result in considerable expense, loss or inconvenience, the work shall not be commenced until all arrangement for the protection thereof have been made. The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangements operations in order that these operations may progress in a reasonable manner and that duplication of rearrangement work may be reduced to a minimum and that services rendered by those parties will not be unnecessarily interrupted.

In the event of interruption to water or utility services as a result of accidental breakage, or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority in the restoration of service. If essential public utility service is interrupted, repair work shall be continuous until the service is restored.

1-B-36 SITE ACCESS ROUTES

The Contractor shall satisfy himself as to the suitability of the access routes he chooses for use during the Contract period. The Employer does not guarantee either the suitability or availability of any particular access route and will not entertain any claim in respect of the non-suitability or non-availability of any such route for continuous use during the Contract period. When needed for the execution of the work, the Contractor shall be responsible for constructing and maintaining temporary access routes at his own expense. The Contractor shall submit for the approval of the Engineer his proposal for the access routes he intends to use and build. He shall be responsible for getting approvals from concerned authorities and/or landowners on the right-of way needed for the construction and use of these access routes.

1-B-37 EXPLOSIVES

When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall be responsible for all damages resulting from the use of explosives. The Contractor shall store all explosives in a secure manner marked clearly in Arabic and English "Danger Explosives". Storage shall be in compliance with all local laws and ordinances. It is the Contractor's responsibility to contact the authorities and secure their approval of his proposed method of storage.

Where no local laws or ordinances apply, storage shall be to the satisfaction of the Engineer and, in general, not closer than three hundred (300) meters from the road or from any building or camping area. In no case shall the Contractor store explosives on the Site without prior approval of the local authorities or the Engineer.

Prior to starting any blasting operations, the Contractor shall submit a written comprehensive system of working to be approved by the Engineer. The system shall be approved by the Engineer prior to blasting. Approval of blasting plans shall not relieve the Contractor of his responsibility or liability for the safety of persons and property.

1-B-38 SETTING OUT OF THE WORKS

The Contractor shall prepare detailed setting out drawings and data sheets as necessary and submit them to the Engineer for approval. Any modifications to the setting out drawings or data sheets required by the Engineer shall be made by the Contractor and resubmitted for final approval.

The Engineer will agree with the Contractor the basic information supplementary to that shown on the Contractor's Drawings such as the position of center-lines and base-lines etc. sufficient for the Contractor to locate the Works. Such supplementary information may be provided on drawings, sketches or in writing.

Should it be necessary during setting out or during construction agreed setting out details to be amended, the Contractor shall amend the drawings or data sheets or make new ones for approval as required by the Engineer.

Copies of setting out drawings and data sheets shall be preserved for use by the Contractor in preparing final records and drawings in accordance with the requirements set out elsewhere.

1-B-39 BOUNDARIES OF WORKS

The Employer shall provide the Site upon which the Permanent Works included in the Contract are to be constructed. The existing boundary fences and walls shall not be disturbed without the prior approval of the Engineer's representative and the carriage way shall be left available to traffic.

The Contractor shall not enter upon or occupy with men, tools, equipment or materials and land other than or rights of way provided by the Employer without the written consent of the owner of such land.

The Contractor shall provide temporary fencing, or immediately install permanent fencing where such is required. Where the Permanent Works do not include fencing the Contractor shall submit his proposals to the Engineer as to how he intends to fulfill his obligations under the Contract which shall be to the approval of the Engineer.

1-B-40 SHOP DRAWINGS / EXECUTION DRAWINGS

The execution drawings shall be prepared in the same manner stated thereafter in the preparation of the shop drawings.

Where the Contract Documents require the Contractor to prepare Shop Drawings, or where required by the Engineer during the course of the work, the Contractor shall submit to the Engineer Shop Drawings that shall satisfactorily establish actual details of manufactured or fabricated item and of work to be executed. They shall clearly identify materials, dimensions, thicknesses, components, attachments, relation with adjoining work and spaces, and all other pertinent information. Shop Drawings shall clarify and amplify the design drawings and other design requirements and shall, subject to the Engineer's approval, incorporate minor changes in design or construction as may be necessary to suit the requirements of the work. By submitting Shop Drawings the Contractor thereby represents that he has determined and verified all dimensions, relations to existing work, coordination with work to be installed later, coordination with information in previously submitted Shop Drawings and has verified their compliance with all the requirements of the Contract Documents.

The accuracy of all such information is the responsibility of the Contractor and in reviewing Shop Drawings the Engineer shall be entitled to rely upon the Contractor's representation that such information is correct and accurate.

The Contractor shall be responsible for and shall make any alterations in the work due to discrepancies, errors or omissions in the Shop Drawings supplied by him whether or not such Shop Drawings have been approved by the Engineer.

1-B-41 AS-BUILT DRAWINGS

The Contractor shall submit final as-built record drawings to the Engineer for his review by the specified date. After review and approval by the Engineer of the final as-built drawings, the Contractor shall within 10 days thereof, produce a final set of "as-built drawings" and submit to the Engineer the following:

a. One (1) computerized copy of each as-built drawing on CD.
b. 3 prints of each as-built drawing.

1-B-42 LEVEL DATUM

Where possible, construction drawings and all levels used for construction shall be referred to the National Height Datum. The Contractor shall be responsible for obtaining the location of the permanent bench marks. In cases where such bench marks do not exist, the site datum shall be agreed with the Engineer.

Levels of reservoirs, pumping stations, boreholes, pipes, treatment plant and the like shall be referred to the National Height Datum.

Before the commencement of construction works, the Contractor shall establish at each site in a position, to the approval of the Engineer, a steel datum peg which shall be securely concerted in. The level of this pet shall be established and agreed with the Engineer and all levels used in the construction of the Works shall be referred to this established datum. The correctness of this established datum shall be checked at regular intervals during the construction period as agreed with the Engineer.

1-B-43 LEVELS AND DIMENSIONS

Wherever dimensions or levels are not shown on the Drawings, instructions shall be obtained from the Engineer.

1-B-44 BENCHMARKS

Benchmarks in the area of the work shown on the drawings shall be established by the Contractor.

The Contractor shall be responsible for preserving these benchmarks and re-establishing them in case they are destroyed.

The Contractor shall establish at his own expense temporary benchmarks he might need for the execution of the work.

1-B-45 SIGN BOARDS AND SAFETY BARRIERS

The Contractor shall provide two site sign boards in a form and to the specification specified and erect and mount on suitable temporary supports, in positions and at heights as required by the Engineer.

The Contractor shall maintain, alter, move and adapt the sign boards from time to time as instructed by the Engineer. The display of any named Subcontractors or any other information associated with the Works shall be to the approval of the Engineer.

The Contractor shall provide safety barriers to protect the public, in a form and to the specification specified. The safety barriers shall be erected each side of all open trench and other excavations and at such other locations as required by the Engineer.

Sign boards and safety barriers will not be paid for directly but shall be deemed to be included in the rates of other items of the project.

1-B-46 FLAGGING, LIGHTING, WATCHING AND TRAFFIC CONTROL:

Where necessary for the safety of the public or where required by the Engineer or his Representative the whole of the Works shall be properly fenced, signed and lighted from half an hour before sunset until half-an-hour after sunrise and at other times when visibility is poor. On all occasions the Works shall be properly flagged. The lamps shall be approved by the appropriate Authority and shall be kept in a clean and proper condition. The position and number of the lamps shall be such that the extent and position of the works is clearly defined and the arrangement shall comply with the requirements of the appropriate Authority. Each site of the Works shall be provided with night and week-end watchmen as may be required.

1-B-47 TEMPORARY WORKS

The Contractor shall be responsible for designing and constructing any temporary works he requires to undertake the construction of the project. These works shall be to the approval of the Engineer. At Contract completion, the Contractor shall be responsible for removing all temporary works and reinstating the site unless the Employer wishes to purchase some of these works at a mutually agreed price and thereby give them the status of permanent works.

1-B-48 CLEANING THE SITE

During the execution of the work, the Contractor shall keep the site clean by removing and carting away to approved dumping sites all rubbish, debris, wastes, etc.
Upon completion of the work and before acceptance and final payment will be made, the Contractor shall clean the Site and property defaced or occupied by him. He shall clear in connection with the Work all rubbish, excess materials, debris, false work, temporary structure and equipment.
All parts of all types of the Work shall be left in a neat and presentable condition and as approved by the Engineer.

1-B-49 CONTRACTOR'S YARDS, STORES AND ACCOMMODATION FOR WORKMEN

The Contractor shall make his own arrangements for all land, yards, stores, workshops, offices etc. and for all services in connection therewith.

The location of all yards, stores, workshops, offices, etc. shall be agreed beforehand with the Engineer and shall be such as to avoid obstruction and nuisance to the public.

The Contractor shall construct on the Site, or at suitable locations, secure storage compounds and storage buildings where he shall store at his own risk all equipment and plant delivered to Site and awaiting erection. The compound shall be of sufficient size to accept all such plant delivered and awaiting erection.

Storage buildings shall be weatherproof and shall be of sufficient size to accommodate all items requiring covered storage.

The storage compounds and buildings shall be completed prior to delivery of any items of plant and equipment.

The Contractor shall provide and maintain suitable and sufficient shelters and mess rooms for his workmen and supervisory staff as are customary and necessary.

The Contractor shall provide sufficient closets or latrines to the satisfaction of the relevant authority. They shall be properly screened and maintained in a clean and sanitary state at all times.

The mess rooms, closets and latrines shall be located in positions to be approved by the Engineer. The Contractor shall be responsible for making all arrangements for the proper disposal of waste from mess rooms, closets and latrines.

Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Any costs for the use of privately-owned land for storage and/or for the placing of the contractors' plant and equipment shall be borne by the contractor. Private property shall not be used for storage purposes without written permission and release of the owner or lessee, and a copy of such written permission and release shall be furnished to the Engineer prior to any use of the land by the contractor.

1-B-50 DUMPING SITES

The Contractor shall remove and cart away all rubbish, excess materials, debris, etc. to dumping sites approved by the Engineer. It shall be the Contractor's sole responsibility to establish the locations of these sites and get the necessary approvals from concerned authorities for using them.

Dumped material shall be spread over the whole area of the dumping site in layers not exceeding 80 cms. In case a dumping site is abandoned, the Contractor shall grade the area in an acceptable manner and to the satisfaction of the Engineer.

1-B-51 DISMANTLED ITEMS

All items dismantled by the Contractor shall be considered the property of the Employer, and they shall be disposed of as instructed by the Engineer.

Part 11: Pipelines

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PART 2 - PIPELINES

2-A GENERAL REQUIREMENTS

2-A-1 INSTALLATION OF PIPES

2-A-1-1 *General*

Excavation of any part of the project is not allowed until a full supply of pipes and fittings are available on site.

Before using pipes, special parts and apparatuses should be installed on site and thoroughly cleaned and cleared out from any undesirable element.

During pipe laying, all precautions shall be taken to avoid ingress inside the pipe of any foreign material, dirt or soil.

Pipes are lowered down in the trench with adequate equipment and shall be placed in the right position for the jointing purposes.

Pipes and special pieces and apparatus shall be brought down in the trench carefully avoiding any sudden shocks or falls, etc.

Placing and installing the pipes shall be performed by experienced laborers.

During the course of the work(s) executed within the water table it is necessary to keep the trench bottom dry during the placing of gravel or sand pipe bedding.

Temporary wedges shall be placed to get the proper alignment and at the change of direction. These wedges shall be made of compacted earth heaps or wood pieces. Using stone wedges will not be allowed. However, concrete pipes shall be laid on a temporary basis made from solid materials (calcalitrated stones).

Pipe ends shall be temporarily closed with wooden, plastic flanges or with special pieces during the stopping of the works.

2-A-1-2 *Excavation For Pipe Trench*

See PART III-1- EARTHWORK.

2-A-1-3 *Pipe Installation In Trench*

- All pipes and fittings are to be present on site and ready for installation by well trained and professional crew.
- Examine and clean all pipes and fittings before installation. Damaged items are to be removed immediately from site for repair or disposal.
- In case of pipe cutting, use slitting disc type cutter or an air operated saw for larger pipes. After cutting and before assembly, it is essential to fillet or chamfer the edge of the cut with file. Finally restore the protective coating on the pipe areas affected by the cutting operations if applicable.
- Install pipes to the invert / crown level indicated on the longitudinal profile using proper survey tools.
- Pipes shall not be dragged along the trench bottom.

- Ensure inner and outer coatings are not damaged and pipe is clean.
- Examine the pipe visually against any break of hair cracks, bends, bumps or deflection along pipe length.
- Use proper ropes and protected hooks when handling pipes.
- Use pieces of soft wood when leveling the pipes in the trench. Do not use stones, bricks, etc… this may damage the coating.
- Install joints as specified on the drawings and where needed and as directed by the Engineer.
- Do not leave ends of pipes opened if installations stopped. Use tight lids supplied by manufacture.
- Whenever part or section of pipes, not exceeding 500 meters, is installed in the trench. Submit a written request for pressure testing before backfilling and compacting the pipe trenches.
- Each portion of pipeline shall be a full pipe span, as much as possible in order to reduce to the minimum pipe joints.
- Pipes and fittings laid in trench shall have at least the minimum cover stated on the Drawings.
- Long radius curves in buried pipelines shall be negotiated by deflections taken up in one or more pipes. The deflection in pipeline shall not exceed the specified limits.
- Pipes shall be laid with a minimum gradient of 1 in 500.

2-A-1-4 *Backfilling Pipe Trenches*

See PART III-1- EARTHWORK

2-A-2 CUTTING PIPES

2-A-2-1 *General*

Before cutting the pipe, it is essential to measure the external diameter at the cutting point with a circumference tape or compass calipers, to check that it is compatible with the intended coupling joint dimensions.

Use hacksaws, manually operated wheel cutter or pipe cutting machine as per manufacturer's instructions. Prepare ends according to the type of joint used and follow manufacturer's recommendations. Take care not to damage lining of other type pipes associated with main pipes. Repair on site, minor damage, if permitted.

After making the cut, and before assembly, it is essential to bevel / chamfer the edges of the cut with a file.

2-A-2-2 *Ductile Iron Pipes*

Ductile iron pipes shall only be cut with an approved mechanical pipe cutter in conformity with the pipe manufacturer's recommendations. The use of an oxyacetylene flame cutter will not be permitted. The edges of the cut together with those parts of the pipes from which the coating has been removed shall be given two coats of bituminous paint and the internal lining repaired. When the cut pipe is to be inserted in a "Tyton" type joint it shall be beveled for 10mm at 30° to pipe the axis.

2-A-2-3 Polyethylene

Pipes shall be cut with an approved mechanical pipe cutter and in conformity with pipe manufacturer's recommendations. Where the cut end of the pipe is to be incorporated in a joint the pipe shall be turned down to the correct diameter required for forming the joint by an approved mechanical turning machine. The length of turning shall be sufficient to enable the joint to be properly made the ends of the pipe shall be accurately beveled by mechanical means to the dimensions specified in the manufacturer's recommendations.

2-A-3 CONCRETE SURROUNDING PIPES

2-A-3-1 General

All concrete works shall comply with the appropriate requirements of PART III-2- CONCRETE AND MASONRY.

Concrete surround shall be broken at all pipe joints to retain flexibility in the pipeline in case of shallow pipes, except for pipes crossing under watercourse, the concrete surrounding shall be continuous and rigid.

When pipes intersect with other utilities, the pipe shall be surrounded with concrete, the joints at such crossing shall be ridged.

All concrete encasements shall not be executed without the prior approval of the Engineer.

2-A-3-2 Materials

Concrete bedding: cast in situ CLASS "C".

Concrete encasement with reinforcement: cast in situ CLASS "B".

2-A-3-3 Placing Concrete

After placing pipe, place concrete in trench and thoroughly work under the pipe to provide solid and uniform bedding.

Place the balance of concrete on both sides of the pipe simultaneously.

Introduce vertical construction joints in concrete beds, surroundings etc. at the face of pipe joint with compressible board and finish to profile of concrete and pipe. Fill any gap left in concrete with approved resilient material.

2-A-4 RESTORATION OF SURFACE

1- General: Proceed with surface restoration as soon as other practicable works is completed, but in no case more than 10 days after backfilling of the trench and other excavated areas and complete within a further 20 days.

2- Restoration of asphalt, concrete and/or gravel pavements are to be brought back to its original thickness and materials to match the existing pavement. Material and workmanship are to be in according to the local municipality requirements or as directed by the Engineer.

3- Restoration of pavement: Repave to match existing pavements in quality, shape, size and level to a uniform surface finish with existing surface.

4- Restoration of grassed areas: After backfilling is compacted and brought to the bottom of the previous top soil level, spread approved fertilized soil over affected area and seed, Continue fertilizing and watering until grass is restored to its former condition.

5- Restoration of unsurfaced area: Bring backfill to natural ground level, well compacted and distributed evenly.

2-B DUCTILE IRON PIPES & FITTINGS

All ductile iron pipes and fittings to be supplied under this Specification shall be obtained from an approved manufacturer having an ISO9001-2000 TOTAL QUALITY ASSURANCE system based on the latest version of the ISO9001 standard.

2-B-1 SOCKET AND SPIGOT PIPES

Ductile iron socket and spigot pipes shall be centrifugally cast in accordance with the European Standard EN 545-2002.

Each pipe shall be subjected, in accordance with the European Standard EN 545-2002, to a hydrostatic works test at the following pressures:

DN	Hydrostatic pressure Bar
60 to 300	50
350 to 600	40
700 to 1000	32
1100 to 2000	25

2-B-2 FLANGED PIPES

Ductile iron flanged pipes shall be manufactured in accordance with the European Standard EN 545-2002. The flanged joint ISO PN 16 or ISO PN 25 whose drilling shall comply with International Standard ISO 7005-2 ISO PN 16 or ISO PN 25 insures the water-tightness.

2-B-3 FITTINGS

The ductile iron fittings shall be sand cast in accordance with the European Standard EN 545-2002.

The water-tightness is insured by the joint, which shall be of the:

- STANDARD push in joint where fittings are used with Socket and Spigot pipes.
- SELF-ANCHORED push in joint where fittings are used with Socket and Spigot pipes and where there is a need to take up the axial forces.
- FLANGED joint where fittings are used with flanged pipes.

Each fitting shall be subjected, in accordance with the European Standard EN545-2002, to a work leak tightness test carried out under a one bar air pressure.

2-B-4 LAYING AND JOINTING

2-B-4-1 Laying

Before Ductile Iron is laid, all dirt and foreign matter shall be removed from inside and all lumps blisters, excess coal tar, oil, grease and moisture shall be eliminated from the surfaces the joints. After the pipe is laid and mounted, care shall be taken to avoid entrance of dirt, water and foreign matter from the trench or from elsewhere by use of light bulkheads.

2-B-4-2 *Jointing*

Joints of Ductile Iron Pipes and Fittings shall be of the **Push** in automatic standard type and where there is a need to take up the axial forces, necessary Self Anchored push in joint shall be used which allows concrete anchor blocks to be dispensed with. Flanged jointing shall be used for pipes inside reservoirs and valve chambers.

2-B-4-3 *Lubricant Paste*

The lubricant paste shall be a mixing of Vaseline, non soluble in accordance with French standard AFNOR T90 M DOC8. The quantities used in the assembly joints shall be as per manufacturer recommendation. It shall be supplied by the Pipes and fittings manufacturer.

2-B-5 CONNECTING PIECES

All connecting pieces i.e. flexible coupling, flange adaptors, dismantling joint shall be made of ductile iron and shall be supplied from the same pipes and fittings manufacturer.

2-B-6 LININGS AND COATINGS

2-B-6-1 *Pipes Internal Protection (Including Welded Flanged Pipes)*

Pipes shall be internally lined with sulphate resisting blast furnace slag cement applied by a centrifugal process. The cement mortar lining shall be in accordance with the International Standard ISO 4179-1985 with the thickness given in following table:

	Thickness of mortar	
	Nominal mean Value Mm	**Tolerance Mm**
80 – 300	3.5	- 1.5
350 – 600	5	-2
700 – 1200	6	-2.5
1400 - 2000	9	-3

2-B-6-2 *Pipes External Protection (Including Welded Flanged Pipes)*

Pipes shall be externally coated with:

- A metallic zinc coating in accordance with the International Standard ISO 8179 Part 1-1995. The quantity of zinc shall not be less then 200 g/m2.
- A bituminous varnish or equivalent (Metallic zinc with synthetic resin) anticorrosive paint which shall be applied over the zinc coating in accordance with the International Standard ISO 8179 Part 1-1995, with a minimum thickness of 100 microns.

2-B-6-3 *Fittings Internal and External Protection*

The fittings shall be internally and externally protected with a bituminous varnish with a minimum thickness of 70 microns or with an epoxy coating applied by a cataphoresis process ensuring an equivalent protection. The type of the coating depends of the diameter of the fittings.

2-B-6-4 *Connecting Pieces Internal And External Protection*

The connecting pieces (Flexible couplings, Flange adaptors, dismantling joint) shall be internally and externally protected with a powder Epoxy coating having a minimum thickness of 150 microns or with a rilsan nylon coating having a minimum thickness of 200 microns. The type of the coating depends of the diameter and the type of the connecting pieces.

2-B-7 HYDROSTATIC PRESSURE TESTING

Pressure pipelines shall undergo a hydrostatic pressure test. They shall be tested in sections not larger than 500 m, or as may be directed by the Engineer, and tests shall be made only on sections which are completed, except for backfilling over joints and fittings which are to be left exposed for inspection. Weights and thrust blocks intended to prevent lateral and vertical displacement of the pipes or specials must be completed and must have attained their design strength before tests are commenced.

Test sections shall be preferably carried out between shut-off or sectioning valves. Where this is not practicable, test sections shall be sealed off by suitable bulkheads, properly braced.

Prior to testing, air shall be evacuated from the line by filling it with water with all valves and taps open. After the first filling and the closing of all valves and taps, the water shall remain in the line for at least 24 hours to allow for absorption, and water being added as required to make up for losses. During this period the Contractor shall inspect the line and all fittings and valves installed on it for leaks. Any leaks found shall be promptly repaired by the Contractor, who shall then proceed with the test, unless otherwise noted on the drawings, in the particular specifications, or by the Engineer, the "Test pressure" measured at the lowest point of the section shall be equal to one of the following values:

For pressure gravity driven pipelines:

1) Test pressure shall be equal to (1.5 x Rated Working Pressure) for rated working pressure equal to or less than 10 kg/cm^2.

2) Test pressure shall be equal to (Rated Working Pressure + 5 kg/cm^2.) for rated working pressures exceeding 10 kg/cm^2

For lift pipelines:

Test pressure shall be equal to Rated working pressure plus calculated water hammer surge plus 2 kg/cm^2.

The water hammer surge will be calculated as follows: $\Delta H = a\,\Delta V / g$

where:

ΔH = Water hammer surge
ΔV – design velocity as indicated on the drawings expressed as meter per second. a =

surge velocity expressed as meter per second (a = 1100m/s).

g = acceleration due to gravity in meters per second per second = 9.81 m/s^2.

The pressure shall be slowly raised by pumping to the required "Test Pressure". Pumping shall then be discontinued, the pump disconnected, and the line kept under pressure for at least 30 minutes. For the line to be accepted, the pressure shall not drop by more than 0.2 kg/cm^2 during the said 30 minutes period and there shall be no visible leaks at joints, fittings, valves, etc. Should the drop of pressure exceed this value, the Contractor shall search for the defects causing such pressure drop, shall make all necessary repairs and repeat the test until the section under test meets the requirements. Provided always that all visible leaks must be repaired whatever the

loss of pressure. The Contractor shall at his own cost provide all necessary test pumps, pressure gauges, cocks and other accessories and shall make such temporary connections as may be required for filling and testing the line in the manner herein specified.

The water used for pressure testing shall be provided by the Contractor and shall be free from impurities and of such a quality which will not pollute or injure the pipeline. The Contractor shall be responsible for obtaining the water, transporting it and for its safe disposal on completion.

2-C POLYETHYLENE PIPES

2-C-1 GENERAL TERMS AND CONDITIONS

2-C-1-1 Scope

This specification covers requirements for polyethylene piping system (pipe and fittings) for the supply of water under pressure intended for human consumption both above ground and in buried pipe applications.

2-C-1-2 Engineered And Approved Plans

Construction shall be performed in accordance with engineered construction plans for the work prepared under the direction of a Professional Engineer.

2-C-1-3 Referenced Standards

The most recent ISO standards or European Norms EN12201 / EN12202 or DIN 8074 / 8075 shall apply.

2-C-1-4 Inspections

All work shall be inspected by an Authorized Representative of the Owner who shall have the authority to halt construction if, in his opinion, these specifications or standard construction practices are not being followed. Whenever any portion of these specifications is violated, the Project Engineer or his Authorized Representative shall, by written notice, order further construction to cease until all deficiencies are corrected. A copy of the order shall be filed with the Contractor's license application for future review. If the deficiencies are not corrected, performance shall be required of the Contractor's surety.

2-C-1-5 Warranty and Acceptances

The Contractor shall warrant all work to be free from defects in workmanship and materials for a period of [one year] from the date of completion of all construction. If work meets these specifications, a letter of acceptance, subject to the [one year] warranty period, shall be given at the time of Completion. A final acceptance letter shall be given upon final inspection at the end of the [one year] warranty period, provided the work still complies with these specifications. In the event deficiencies are discovered during the warranty period, they shall be corrected b the Contractor without additional charge to the owner before final acceptance. During the warranty period, the Project Engineer shall determine if warranty repairs or replacement work shall be performed by the Contractor. The decision of the Project Engineer shall be binding upon the Contractor.

2-C-1-6 *Qualification Of Manufacturers*

The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications. The manufacturer's production facilities shall be open for inspection by the Owner or his Authorized representative. Qualified Manufacturers shall be approved by the Project Engineer.

2-C-1-7 *Approved Manufacturers*

Manufacturers must be pre-qualified and pre-approved by the Project Engineer. Products from unapproved manufacturers are prohibited.

2-C-2 POLYETHYLENE PIPES / FITTINGS

2-C-2-1 *Raw Materials*

The polyethylene compounds used in the manufacture of products furnished under this specification shall be made from compounded pellets obtained by the addition of the correct type and amount of *carbon black* and necessary antioxidants and other additives to protect the pipe during extrusion and assure the life expectancy of the pipe. ***Pipe produced by the addition of black masterbatch to polyethylene is strictly forbidden***. The compound material shall comply with the requirements as specified in EN 12201-Part 1.

Typical material properties as described by the Raw Material Supplier brochure shall be submitted to the project engineer for analysis and verification of compliance. These properties are not to be misconstrued as specification minimums.

All Raw Material used shall be approved and certified ***Pipe Grade Material*** for the transportation of potable water.

2-C-2-2 *Polyethylene Pipe*

2-C-2-2-1 *Pipe Coil*

Pipes with OD up to 110 mm shall be supplied in coils where the inside diameter of the coil is 30 times OD. Pressure pipes with OD of 140mm and above shall be supplied in straight lengths. When needed special pipe length can be supplied with the approval between purchaser and manufacturer.

2-C-2-2-2 *Marking of Pipe*

All pipes shall bear permanent identification markings that will remain legible during normal handling, storage, installation, and service life and that have been applied in a manner that will not reduce the strength nor otherwise damage the products. The marking shall not initiate any defects in the surface and will not provide leakage channels when elastomeric gasket compression fittings are used to make joints. Both hot tape marking and Ink Jet printing are acceptable.

Marking on pipe shall include the following and shall be applied at intervals of not more than 1.5 meters:

1) Normal size (i.e. 90mm)
2) Standard PE designation (i.e. PE-HD PE 100)
3) The Standard Dimension Ratio (i.e. SDR 11)
4) Marking the product with the applicable standards designation (EN 12201).
5) Production date
6) Nominal pressure rating of pipe (i.e. PN10)
7) Manufacturer's Name
8) Country of production

2-C-2-2-3 Service Identification Stripes

PE Pipes shall be permanently color-coded with stripes for instant identification as potable water service pipes. Stripes shall be provided by co-extruding four (or more) equally spaced blue color stripes into the pipe outside surface. The striping material shall be the same material as the pipe material except for color. ***Stripes printed on the pipe outside surface shall not be acceptable***.

2-C-3 MANUFACTURER'S QUALITY CONTROL

The pipe manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming PE materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier, and verified by Manufacturer's Quality Control. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing materials shall be checked for:

a) Outside diameter and wall thickness as per EN 12201-Part 2 at a frequency of at last once/hour or once/coil, whichever is less frequent.
b) Out of Roundness at a frequency of at least once/hour or once/coil whichever is less frequent.
c) Quality Control shall verify production checks and test for:
d) Melting Index as per ISO 1133 at a frequency of at least once per extrusion lot.
e) Hydrostatic Strength testing (up to Ø110mm) as per EN 921 at a frequency of at least once per day per line.
f) All fabricated fittings shall be inspected for joint quality and alignment.

2-C-3-1 Permanent Records

The Manufacturer shall maintain permanent QC and QA records.

2-C-3-2 Compliance Tests

Manufacturer's inspection and testing of the materials. In case of conflict with Manufacturer's certifications, the Contractor, Project Engineer, or Owner may request retesting be the Manufacturer or have retests performed by an outside testing service. All retesting shall be at the Contractor's expense, and shall be performed in accordance with the Specifications.

2-C-4 CHARACTERISTICS

2-C-4-1 *External Aspect Of Pipes*

Pipe surface shall be smooth, free from scoring, pinholes, and other surface defects. Pipe ends must be cut clean and perpendicular to the axis of the pipe. End caps at pipe extremities are required in order to prevent unwanted matter entering the pipe during storage.

2-C-4-2 *Engineering Characteristics*

The limitation on the outside diameter and ovality shall confirm to PR-EN 12202-2 as follows:

Ovality	OD Max	OD Min	OD
1.2	16.3	16.0	16
1.2	20.3	20.0	20
1.2	25.3	25.0	25
1.3	32.3	32.0	32
1.4	40.4	40.0	40
1.4	50.4	50.0	50
1.5	63.4	63.0	63
1.6	75.5	75.0	75
1.8	90.6	90.0	90
2.2	110.6	110.0	110

The pipes thickness shall depend on the properties used in manufacturing, and shall conform to PR-EN 12202-2 and nominal pressures of PN10, PN12.5 and PN16 bars for PE80 material, and PN10, PN12.5, PN16 and PN20 bars for PE100 material.

STANDARD: PR-EN 12201 - 2/TC 155									
PE 80 MATERIAL									
	PN 10			PN 12.5			PN 16		
	SDR 13.6 S-6.3			SDR 11 S-5			SDR 9 S-4		
OD	E min.	E max.	ID (*)	e min.	e max.	ID (*)	e min.	e max.	ID (*)
Mm	Mm	mm	mm	mm	mm	mm	mm	mm	mm
16	-	-	-	-	-	-	2.0	2.3	11.7
20	-	-	-	2.0	2.3	15.7	2.3	2.7	15.0
25	2.0	2.3	20.7	2.3	2.7	20.0	3.0	3.4	18.6
32	2.4	2.8	26.8	3.0	3.4	25.6	3.6	4.1	24.3
40	3.0	3.5	33.5	3.7	4.2	32.1	4.5	5.1	30.4
50	3.7	4.2	42.1	4.6	5.2	40.2	5.6	6.3	38.1
63	4.7	5.3	53.0	5.8	6.5	50.7	7.1	8.0	47.9
75	5.5	6.2	63.3	6.8	7.6	60.6	8.4	9.4	57.2
90	6.6	7.4	76.0	8.2	9.2	72.6	10.1	11.3	68.6

110	8.1	9.1	92.8	10.0	11.1	88.9	12.3	13.7	84.0
125	9.2	10.3	105.5	11.4	12.7	100.9	14.0	15.6	95.4
140	10.3	11.5	118.2	12.7	14.1	113.2	15.7	17.4	106.9
160	11.8	13.1	135.1	14.6	16.2	129.2	17.9	19.8	122.3
180	13.3	14.8	151.9	16.4	18.2	145.4	20.1	22.3	137.6
200	14.7	16.3	169.0	18.2	20.2	161.6	22.4	24.8	152.8
225	16.6	18.4	190.0	20.5	22.7	181.8	25.1	27.8	172.1
250	18.4	20.4	211.2	22.7	25.1	202.2	27.9	30.8	191.3

OD = Outside Diameter

ID (*) Average Inside Diameter

e = Wall Thickness

PN = Nominal Pressure Ratings in Bar

STANDARD: PR - EN 12201 - 2/TC 155

PE 100 MATERIAL

	PN 10			**PN 12.5**			**PN 16**			**PN 20**		
	SDR 17			**SDR 13.5**			**SDR 11**			**SDR 9**		
	S-8			**S-6,3**			**S-5**			**S-4**		
OD	e min.	e max.	ID(*)	e min.	e max.	ID(*)	e min.	e max.	ID(*)	e min.	e max.	ID(*)
mm	Mm	Mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
16										2.0	2.3	11.7
20							2.0	2.3	15.7	2.3	2.7	15.0
25				2.0	2.3	15.7	2.3	2.7	20.0	3.0	3.4	18.6
32	2.0	2.3	27.7	2.4	2.8	20.0	3.0	3.4	25.6	3.6	4.1	24.3
40	2.4	2.8	34.9	3.0	3.5	25.6	3.7	4.3	32.1	4.5	5.1	30.4
50	3.0	3.4	43.8	3.7	4.2	32.1	4.6	5.2	40.2	5.6	6.3	38.1
63	3.8	4.3	55.3	4.7	5.3	40.2	5.8	6.5	50.7	7.1	8.0	47.9
75	4.5	5.1	65.7	5.6	6.3	50.7	6.8	7.6	60.6	8.4	9.4	57.2
90	5.4	6.1	78.8	6.7	7.5	60.6	8.2	9.2	72.6	10.1	11.3	68.6
110	6.6	7.4	96.4	8.1	9.1	72.6	10.0	11.1	88.8	12.3	13.7	84.0
125	7.4	8.3	108.6	9.2	10.3	88.9	11.4	12.7	100.9	14.0	15.6	95.4
140	8.3	9.3	122.8	10.3	11.5	100.9	12.7	14.1	113.2	15.7	17.4	106.9
160	9.5	10.6	140.4	11.8	13.1	113.2	14.6	16.2	129.2	17.9	19.8	122.3
180	10.7	11.9	157.4	13.3	14.8	129.2	16.4	18.2	145.4	20.1	22.3	137.6
200	11.9	13.2	174.9	14.7	16.3	145.4	18.2	20.2	161.6	22.4	24.8	152.8
225	13.4	14.9	196.7	16.6	18.4	161.6	20.5	22.7	181.8	25.2	27.9	171.9
250	14.8	16.4	218.8	18.4	20.4	181.8	22.7	25.1	202.2	27.9	30.8	191.3

OD = Outside Diameter

ID (*) = Average Inside Diameter e

= Wall Thickness

PN = Nominal Pressure Ratings in Bar

2-C-4-3 *Mechanical Characteristics*

All manufactured pipes shall pass the stress test conforming to the requirements of PR-EN 12202-2 using test method of EN 921/ISO 1167. Stress test shall be the deciding factor in accepting or refusing the pipe.

Produced pipes shall pass the internal pressure test (acceptance test) using test method per EN 921.

PE class	Reqts	Stress	Temp.
PE 100	>100hrs	12.4MPa	20 °C
PE 80	>100hrs	10.0MPa	20 °C

Note: The Contractor must give the Engineer a report specifying that the pipes he will install fits with the specifications described.

2-C-4-4 *Effect of temperature on working pressure of PE Pipe*

Nominal pressure of PE pipes is the service pressure at 20°C with a service life of 50 years. For the use of Polyethylene pipes at higher temperature (up to a maximum of 60°C) the maximum working pressure according to the following table, should be reduced as shown on the following chart. These values are based on a pipe life time of 50 years.

- ***Permissible Working Pressures For Pipes Transporting Water***

Temperatnre in °C	Years of service	1	2	3	4	5	6
		Pressure rating					
		PN 2.5	PN 3.2	PN 1	PN 6	PN 10	PN 16
		Permissible working pressure					
10	1	3.4	4.3	5.4	8	13.4	21.4
	5	3.2	4.1	5.1	7.7	12.8	20.5
	10	3.2	4	5	7.6	12.6	20.2
	25	3.1	3.9	4.9	7.3	12.2	19.5
	50	3	3.8	4.8	7.2	12	19.2
20	1	2.9	3.8	4.8	6.8	11.4	18.2
	5	2.7	3.5	4.3	6.6	10.8	17.3
	10	2.7	3.4	4.2	6.4	10.8	17
	25	2.6	3.3	4.2	6.2	10.4	16.6
	50	2.5	3.2	4	6	10	16
30	1	2.5	3.1	3.9	5.9	9.8	15.7
	5	2.4	3	3.8	5.6	9.4	15
	10	2.3	2.9	3.7	5.5	9.2	14.7
	25	2	2.5	3.1	4.7	7.8	12.5
	50	1.7	2.2	2.7	4.1	6.8	10.9
40	1	2.1	2.7	3.4	5	8	13.4
	5	1.8	2.3	2.9	4.3	7.2	11.5
	10	1.8	2	2.5	3.7	6.2	9.9
	25	1.8	1.7	2.1	3.1	5.2	8.3
	50	1.2	1.5	1.8	2.8	4.6	7.4

Temperature in °C	Years of service	1	2	3	4	5	6
		Pressure rating					
		PN 2.5	PN 3.2	PN 1	PN 6	PN 10	PN 16
		Permissible working pressure					
	1	1.7	2.2	2.7	4.1	6.8	10.9
	5	1.2	1.5	1.9	2.9	4.8	7.7
50	10	1.1	1.3	1.7	2.5	4.2	6.7
	15	1	1.3	1.8	2.4	4	6.4
60	1	1.2	1.5	1.0	2.9	4.8	7.7
	5	-	1.1	1.4	2	3.4	5.4

Note: These working pressures do not apply for pipes exposed to UV radiation. The effect of such radiation can be eliminated or considerably reduced for up to ten years of service by the inclusion of suitable additives in the molding material.

2-C-5 PIPE CONNECTIONS

There are seven acceptable methods of joining polyethylene pipe with each other and with other pieces such as valves, flanges, etc.

1- Plastic Compression connection

2- Metal (ductile Iron) Compression connection 3-

Electrofusion Fittings

4- Flange connection

5- Fabricated Fittings

6- Butt Fusion Welding

7- Special tapping fittings

2-C-5-1 *Plastic Compression Fittings for PE Pipes*

This type uses mechanical anchoring that holds the pipe in place (clamp ring usually made of Acetalic resin or C-PVC)and a sealing gasket (EPDM or Rubber/food approved) to create a tight grip and prevent water from leaking. Pipes must be pushed inside the fiting without the necessity to disassemble the fittings. The following pipe OD to PN must apply:

- Pipes up to OD = 63mm with pressure rating maximum PN16
- Pipes OD = 75mm up to 110mm maximum PN10. For PN16 applications metal compression fittings or electrofusion fittings should be used.
- Pipes OD >110mm plastic compression fittings are not used. Metal compression fittings or electrofusion fittings should be used.

All fittings must pass the testing requirements of ISO 3458/3459/3501/3503.

2-C-5-2 *Metal (ductile Iron) Compression Fittings for PE Pipes*

When joining polyethylene pipe or for joining polyethylene pipe to another material with metal couplings, those couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins. External joint restraints shall not be used in lieu of fully restrained mechanical couplings. Nominal pressure rating of fittings shall be 16 bar.

Materials used in the manufacturing of steel compression fittings shall conform to the following:

- Body: GGG 400 - DIN 1693 (epoxy coated. see below for detailed reqts)
- Lip Seal: EPDM
- Grip Ring: Ms 58 (dezincification resistant brass)
- Bolts: A2 (stainless Steel)
- All steel compression fittings must be epoxy coated.

2-C-5-3 *Electrofusion Fittings for PE Pipes*

Electrofusion can be used for all polyethylene pipes irrespective of size and pressure rating as long as pipe and fitting are manufactured from polyethylene resin of the same class and series. It is possible to use fittings with higher pressure rating than pipe, but the opposite is strictly forbidden. Nominal pressure rating of fittings shall be 16 bar.

This type of fittings incorporates electrical heating coil that fuses pipe and fitting by sending an electrical current that heats up the polyethylene material of pipe and fitting at a specific voltage for a specified temperature and duration of time after which pipe and fitting fuse together and become integrated on the molecular level. Manufacturer recommendations for the electrofusion operation must be strictly followed.

Electrofusion machines used in the electrofusion process must be supplied by the same manufacturer of fittings. It strictly forbidden to fuse one manufacturer fitting with another manufacturer machine. Installers of Electrofusion fittings must strictly adhere to both fittings and equipment manufacturer's recommended procedures.

2-C-5-4 *Flanged Connections*

Flange connections shall be installed in accordance with the Manufacturer's recommended procedure. Flange faces shall be centered and aligned to each other before assembling and tightening bolts. In no case shall the flange bolts be used to draw the flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be fitted under the flange nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer at least 1 hour after initial assemble, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the Manufacturer. Nominal pressure rating of fittings shall be 16 bar.

Flanged connections shall consist of the following parts/fittings:

- Coupler (Electrofusion)
- Flanged Adaptor

The coupler for jointing plain-end polyethylene (PE) pipe to PE flanged items shall be of the electrofusion type that heats up the PE material of the pipe to the PE material of flanged fitting. Pressure rating of the coupler shall be no less than 16 bar and made of the same PE resin, class and series as the pipe.

The flanged adaptors for jointing plain-end pipe to flanged items shall be of the socket fusion type and made of polyethylene (PE) material of the same class and series as the pipe. Pressure rating of the flanged adaptor shall be no less than 16 bar.

2-C-5-5 *Fabricated Fittings*

Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe. Directional fittings .

such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets. Part drawings shall be submitted for the approval of the Project Engineer.

2-C-5-6 *Butt Fusion Welding*

For pipes with diameters larger than 75mm, joints between end of the pipes and fittings may be made by butt fusion, and joints between the main and saddle branch fittings shall be made using saddle fusion using only procedures that are recommended by the pipe and fitting Manufacturer. The Contractor shall ensure that persons making heat fusion joints have received training according to the Manufacture's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction.

Heat Fusion Training Services - Upon request, the Manufacturer must provide training in the Manufacturer's recommended butt fusion and saddle fusion procedures to the Contractor's installation personnel, and to inspectors representing the Owner.

2-C-5-7 *Tapping Fittings*

Branch connections to the main pipeline i.e. (branch OD 63mm) can be made using either tees or special tapping fittings (saddle fittings). These fittings can be either mechanical type, electrofusion type or metal type (ductile) and should be designed for the connection to polyethylene (PE) pipes

Tapping fittings according to DIN 3543 are provided for welding to PE-HD pipes. They are welded to the main pipe according to the indications of international standards.

Tapping fitting for polyethylene main lines of PVC or PE-HD must have large contact surfaces and particularly for PE-HD special sealing elements in order to limit to a minimum the surface pressure.

When tapping the main pipeline, it is important to adhere to the respective guidelines for the pipe material. Only appropriate drills for the specific purpose, e.g. crown drills with sufficiently dimensioned flutes may be used. The construction of the drill must prevent the milled-out piece from falling into the pipe.

The material of the main pipeline determines the saddle width of the tapping fitting. The minimum width should be 100 mm for mechanically fastened fittings with rubber seals on PE-HD main lines.

2-C-6 INSTALLATION OF POLYETHYLENE PIPE SYSTEM

2-C-6-1 *Foundation & Bedding*

Pipe shall be laid on grade and on a stable foundation. Unstable or mucky trench bottom soils shall be removed, and a minimum of 100mm foundation or bedding of compacted fine gravel or sand shall be installed to pipe bottom grade. Excess groundwater shall be removed from the trench before laying the foundation or bedding and the pipe. A trench cut in rock or stony soil shall be excavated to 100mm below pipe bottom grade, and brought back to grade with compacted fine gravel or sand bedding. All ledge rock, boulders and large stones shall be removed.

3-C-6-2 *Pipe Laying*

a. In case of outdoor temperatures lower than 0°C, it is recommended to lay polyethylene pipes only under application of particular measures. Pipe ends and pipeline elements must be cleared prior to installation, damaged parts must be removed. Cuts are to be executed vertically to the pipe axle with the aid of suitable equipment, e.g. a fine-toothed saw. Cutting of the pipes can be made, too, using a casing cutter for plastic pipes. Burrs and uneven areas are smoothed down using suitable tools, e.g. a shaver or a scraper. The cut ends are then prepared for the jointing method to be used.

b. When lifting pipes with slings, only wide fabric choker slings shall be used to lift, move, or lower pipe and fittings. Wire rope or chains shall not be used. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Worn or defective equipment shall not be used.

c. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material.

d. Do not lay pipe when trench bottom is muddy or frozen or has standing water.

e. Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe and to leave a smooth end at right angles to the axis of the pipe.

f. Unwinding of pipe coils can be carried out by various methods. Pipes with an outside diameter up to 63 mm can be unwound from the coil in a vertical position whilst securing the pipe end. For larger diameters it is recommended to use an unwinding mechanism. The coils can, for instance, be placed flat onto a rotating wooden or steel cross and be unwound manually or with the aid of a slow-moving vehicle.

The pipes must be unwound in a straight manner without any buckling. Spiral unwinding must be avoided.

When unwinding pipes from drums or coils it is essential to pay attention that the pipe end cannot spring outwards when losing the fastening. As considerable forces are released, particularly from the large diameter pipes, take the necessary measures of precaution (danger of accident !). Drums should unwound from the top.

When unwinding the pipes, note that the flexibility of the polyethylene pipes is subject to the ambient temperature. At temperatures near the freezing point, pipes exceeding 75 mm of outside diameter are to be warmed, if possible. This can be carried out by pumping warm water through the coil or by using non-pressurized steam or hot air (max. 100° C).

Temperature changes cause alterations of length. This must be taken into consideration when cutting and installing the pipeline. 1 m of polyethylene pipe will elongate by 0.2 mm per °C in case of an increase in temperature and will shorten by 0.2 mm per °C in case of a decrease in temperature.

Temperature of Pipe laying	Smallest Admissible Bending Radius
20° C	25 x d
10° C	35 x d
0° C	50 x d

Note: Directional changes of the pipeline profile are achieved by installing pipe bends. To a limited degree the elasticity of the pipe material can be used to bend the pipe even without pre-warming. The smallest admissible bending radius must, however, not fall below the values given in the table above.
Pipes passing through a wall must be lead through a protective pipe sleeve which, as far as drinking water pipelines are concerned, must be in accordance with the requirements of DIN 1988.

2-C-6-3 *Backfilling*

Refer to Part III-1- EARTHWORK subsection **"Backfilling Pipe Trenches – Initial Backfill"**.

2-C-6-4 *Final Backfilling*

Refer to Part III-1- EARTHWORK subsection **"Backfilling Pipe Trenches – Main Backfill"**.

Note: Consulting the Manufacturer during installation phases is recommended to obtain detailed information on the methods and techniques used for proper execution.

2-C-7 HYDROSTATIC PRESSURE TESTING

2-C-7-1 *General*

During pressure tests on polyethylene pipes, the properties of the material cause elongation of the pipes to take place. The test results can be further influenced by changes in the temperature of the pipe wall while the test is in progress. This is due to the relatively high coefficient of thermal expansion of polyethylene pipes. The temperature rise in the pipe wall causes a drop in pressure. When carrying out the pressure test, it is, therefore, desirable to keep the temperature of the pipe wall as constant as possible to ensure that the temperatures at the start and finish of the pressure test are at the same level. For this reason, particular importance attaches to the temperature measurement.

It is also important to ensure that each pipeline is carefully vented, since air trapped in the line can influence the variation of the pressure drop with time. Due to an effect similar to that of a compressed-air chamber, the rate of pressure drop diminishes, which in turn could conceal an increase in the rate possibly caused by a leak. Any air still in the line - at joints and fittings - should be dissolved in water during the preliminary test. A pressure drop also results from temperature fluctuations and expansion of the polyethylene pipes.

In order that the often appreciable temperature influences can be largely eliminated, the tests should where possible be carried out at times of day when temperature fluctuations are small. The temperature level should be approximately the same at the start and finish of the test. Preliminary tests are essential in order that the material related elongation of the line can take place. The increase in the volume of a line at a testing temperature of 20°C and at nominal pressure amounts in the case of polyethylene pipes to 1.5 - 2%. This elongation takes place over a period of time, but is almost completed after 12 hours.

With the air vents open, it is expedient to fill the line slowly from its deep point, so that the air can escape. As regards the filling of the line, the following empirical values can be recommended:

OD (mm)	Inflow in l / s
63	0.1
90	0.2
110	0.3
140	0.5
180	0.7
225	1.5

2-C-7-2 *Execution of Test*

The length of the pipeline section to be testing shall be reasonable (less than 500 m). Ensure all fixed point are surely anchored. Pipes shall be backfilled; joints shall be left exposed for inspection. The test section shall be blanked off with steel blank flanges of adequate thickness supported to resist the end thrust forces and shall be filled from the lowest point with all air valves open.

The correct pre-conditioning of the pipeline is absolutely vital for the acceptance of the main test. This preliminary conditioning serves to bring the pressure time and temperature dependent changes in volume to a steady state, thus ensuring that the results obtained during the main test are reliable.

The preliminary conditioning must be carried out using one and a half times nominal pressure of the pipes, to be checked and corrected, if necessary, at two hourly intervals. Duration of the preliminary test is 12 hours.

During the main test, it must be taken into consideration that the polyethylene pipeline material may not have completed the expansion process; Therefore, the main test shall be started no sooner than 2 hours after the last pressure increase in the preliminary tests.

Test pressure during the main test is at 1.3 of pipeline section the nominal pressure and the test duration is 3 hours.

For the main test, the results are deemed to be satisfactory when the pressure loss observed from the pressure of the polyethylene pipeline is less than 0.3 bar after the completion of the main test (after 3 hours).

2-D STEEL PIPES AND FITTINGS

2-D-1 PREAMBLE

The scope of this document is to define the technical terms of reference for steel pipes coated internally and externally.

These terms of reference are based on the internationally established standards dealing with bare pipes, external coatings and internal linings.

The quality system of the supplier conforms with ISO 9001 and APIQ1.

2-D-2 STEEL PIPE

2-D-2-1 *Product Standard for Steel Pipes*

Pipes are spiral seam pipe or butt-welded straight-seam pipes and made in accordance with EN 10224, EN 10217-1, NFA 49 150, DIN 1626 and DIN 2460, BS 534 and BS 3601, or AWWA C200 and with the requirements given hereafter. In case of contradiction between standards and the present terms of reference, the requirements of these terms of reference prevail.

The welding process may be either Submerged Arc Welding (SAW) or Electrical Resistance Welding (ERW).

2-D-2-2 *Specification Of The Steel Material*

Steel material shall meet the requirements of one of the steel grades listed here below:

	EN 10224	BS 3601	NFA 49150	DIN 1626 DIN 2460	API 5L
1	L 235	360	TSE 235	St 37.0	B
2	L 275	430		St 44.0	X 42
3					X 46
4	L 355			St 52.0	X 52

2-D-2-3 *Mechanical Testing*

The mechanical tests are performed on one sample pipe per heat for a maximum of 200 pipes (1:200/heat).

The following tests should be made during manufacturing of the pipes. One sample pipe per heat for a maximum of 200 pipes (1:200/heat):

Tensile test: one test piece from the parent metal for outside diameter ≤ 500 mm, plus one test piece transverse to the weld for outside diameter > 500 mm

Weld Bend test (root ≠ / or Face): two test pieces shall be taken from the end of the pipe

Required values are given in the relevant standard for steel material listed in § 2-D-2.2. Each test is recorded and should be made available to any authorized representative.

2-D-2-4 *Hydrostatic Test*

All pipes are tested, during manufacturing, for leak tightness. Tests are performed at 90% of the Specified Minimum Yield Strength for a duration of at least 6 seconds. Each test is recorded and should be made available to any authorized representative.

For hydrostatic tests on site, and for under pressure use of pipes, refer to the requirements of the hydrostatic pressure testing of the Ductile Iron pipes.

2-D-2-5 *Non-Destructive Testing on Welds*

All pipe welds are 100% ultrasonically tested prior to the hydrostatic tests during manufacturing and on site.

2-D-2-6 *Visual Inspection*

All pipes should be inspected outside, and inside for OD≥711mm only.

2-D-2-7 *Dimensional Inspection*

All pipes should be dimensionally inspected with reference to the required tolerances.

2-D-2-8 *Tolerances*

- Outside diameter (OD): OD ≤ 406.4mm: ± 1%

  OD > 406.4mm: ± 0.75%

- Thickness of the parent material (T): OD ≤ 406.4mm: ±

  10%

  OD > 406,4mm: T ≤ 14.2 mm: +12% / -8% T

  >14.2 mm: · 10% / - 8%

- Ovalisation: ± 1% of the diameter
- Weight of bare pipes:

  ± 10% per pipe

  ± 7.5% per 10 tons'

- Length:
- Minimum length: 6.0 m
- Maximum length: 14.0 m
- Straightness: 0.2% of the length

2-D-2-9 *Ends preparation*

Outside diameter at the pipe ends shall comply with the following: OD ≤

1600 mm: - 0,8 mm ! 2,4 mm

OD ≤ 1800 mm: - 0,8 mm + 3,0 mm OD

≤ 2000 mm: - 0,8 mm + 3,6 mm OD >

2000 mm: - 0,8 mm + 4,2 mm

Pipes are either:

- Beveled with an angle of 30° (-0° / +5°) and a root face of 1.6 mm (± 0.8 mm),
- Equipped with lap joints OD ≤ 1600 mm: minimum overlapping is 80 mm.

2-D-2-10 *Marking*

Pipe markings will indicate, as a minimum:

- The pipe producer,
- Reference product standard,
- Manufacturing reference.

2-D-3 THREE-LAYERS POLYPROPYLENE EXTERNAL COATING

2-D-3-1 *Product Standard for Three-Layers Polypropylene Coating*

Three-layers polypropylene external coating should be applied on steel pipes conforms to NF A 49711 or DIN 30678 and the requirements given hereafter. In case of contradiction between standards and the present terms of reference, the requirements of these terms of reference prevail.

2-D-3-2 *Composition Of The Coating*

The three-layers polypropylene external coating consists of:

- One first layer made of Epoxy powder resin film applied to optimize anti- corrosion protection. Its minimum thickness is 50 microns at any points,
- A second layer made of a copolymer to ensure adhesion between layer 1 and 3,
- A third layer made of an extruded polypropylene coating.

2-D-3-3 *Thickness of the three-layers polypropylene*

Minimum thickness of the three-layers extruded polypropylene coating conforms with: 273

mm < OD ≤ 508 mm: 1.8 mm

508 mm < OD ≤ 762 mm: 2.0 mm

762 mm < OD: 2.5 mm

(OD; outside diameter)

2-D-3-4 *Preparation of The Metal Surface*

Prior to the surface preparation and coating, the metal surface shall be examined free of impurities, i.e. rust, oil, dirt etc. which could be detrimental to the coating adhesion to the pipe.

The pipes are dried and preheated in order to obtain a temperature at least 3°C above the critical dew point just before the coating application.

The degree of surface cleanliness is SA 2.5, defined by Standard ISO 8501-1. The

roughness level is from 40 to 80 microns Rz.

2-D-3-5 *Routine Testing and Inspection*

- Visual inspection: All pipes should be visually inspected.
- Non-porosity test: All pipes should be submitted to the non-porosity test (Holiday's detection tests).
- Cut-back inspection: All pipes are visually inspected at each end.
- Thickness test: Coating thicknesses should be checked on three pipes per production shift, i.e. 3 pipes / 8 hours.

2-D-3-6 *Required Properties*

The three-layers polypropylene external coating should have the following properties:

- Pull-off strength test:

  Adhesion to support at 23° C: > 750N/5 cm

  Adhesion to support at 80° C: > 200 N/5 cm

- Impact strength at 20° C:

  Punch diameter 25 mm: ≥ 10 Nm/mm

- Penetration resistance under punch load: Punch diameter 1,8 mm and Pressure 10 MPa: at 20° C ≤ 0,1 mm

  at 80° C ≤ 0,4 mm

- Bendability: Radius ≥ 20 D
- Resistance to peeling under negative polarization: Average radius of peeling < 10 mm after 7 days at 40° C.
- Electrical non-porosity: No defect at 10 000 V/mm.
- Insulation resistance:

  R (100 days) > 108 Ω m²

  α < 0,2/30 Rgr (55 days)

- Elongation at break (PP):

  ≥ 400 %

- Resistance to ultraviolet rays (PP): 0,75 MFIo ≤ MFI ≤ 1,25 MFIo

  (MFI: melt flow index)

- Heat resistance (PP): MFI ≤ 1,50 MFIo

  (MFI: melt flow index)

- Cracking resistance in a surface wetting medium: No cracked test pieces after 1 000 h at 50° C.
- First layer Epoxy:

  Thickness: e ≥ 0,05 mm

  Degree of polymerization: ★ Tg - ± 3° C Tests should be performed according to NFA 49711.

2-D-3-7 *Ends Preparation*

Cut-backs are:

- For bevelled pipes:

  150 mm from both ends

- For pipes equipped with lap-joints: 150 mm from the spigot end

  120 mm from the bell end External coating is bevelled at the ends.

2-D-4 BITUMEN OR COAL TAR EXTERNAL COATING

Where required or approved by the Engineer and for pipes and fittings of nominal diameters greater than 100mm, the above-described polypropylene external coating could be replaced by reinforced bitumen enamel wrapping, or coal tar enamel wrapping or polyethylene wrapped (buried pipes only).

In addition to the suitable above requirements concerning the pipes ends preparation and the preparation of the metal surfaces, surfaces to be protected shall be thoroughly cleaned to remove all scale, rust, grease or other extraneous matter, by acid pickling, abrasive, mechanical or flame descaling.

Reinforced bitumen or coal tar enamel wrapping shall comprise hot applied, mineral filled, bitumen, or coal tar, giving a minimum finished thickness of 3mm. Reinforcement shall comprise an inner layer of 40 grams/square metre glass tissue, spirally wound with overlap, separated from the pipe surface by at least 1mm thickness of enamel, and an outer sheathing of bitumen or coal tar impregnated, longitudinally reinforced, glass fabric spirally wound onto the pipe with overlap, and separated by at least 1mm of enamel from the inner glass reinforcement.

2-D-5 LIQUID EPOXY INTERNAL LINING

2-D-5-1 Product Standard for Liquid Epoxy Internal Lining

Liquid epoxy internal lining applied on steel pipes should conform to NFA 49709 or AWWA C210 and to the requirements given hereafter. In case of contradiction between standards and the present terms of reference, the requirements of these terms of reference of the present specification prevail.

2-D-5-2 Composition Of the Liquid Epoxy Internal Lining

The internal liquid epoxy is a two-compound product - resin and hardener - which polymerizes at high temperature and the application, is carried-out at high temperature. It shall resist to osmotic blistering and it shall have current potable water certification from an internationally recognized certifying Authority. This certificate shall be enclosed by the Pipe Manufacturer in his offer.

2-D-5-3 Thickness Of the Liquid Epoxy Internal Lining

Thickness of liquid epoxy internal lining measured on a dry film is greater than 300 microns at any point of the surface.

2-D-5-4 Preparation Of the Metal Surface

Prior to coating, the metal surface is free of impurities which could be detrimental to the surface preparation or to the coating adhesion on the pipe.

The pipes are dried and preheated in order to obtain a temperature at least 3°C above the critical dew point just before the coating application.

The degree of surface cleanliness is SA 2.5, defined by Standard ISO 8501-1.

Roughness level is from 40 to 80 microns Rz.

2-D-5-5 *Curing the Internal Coating*

To obtain a good polymerization of the liquid epoxy, the coated pipes, after being painted, should pass through a post cure oven where the steel temperature is raised and maintained at a temperature by the paint manufacturer.

2-D-5-6 *Routine Testing and Inspection*

- Surface conditions inspection: The surface conditions of pipes should be checked after blasting.
- Visual inspection of aspect: All pipes should be visually inspected.
- Cut-back inspection: All pipes should be visually inspected at each end.
- Wet film thickness test: Four measurements of thickness on a wet film should be performed for all the pipes.
- Non-porosity test: An electrical non porosity test should be performed on three plates per production shift.
- Adhesion test: Adhesion of the liquid epoxy lining on plates should be checked on one pipe per production shift.
- Dry film thickness test: The thickness of dry films on plates should be checked on one pipe per production shift.

2-D-5-7 *Properties of The Liquid Epoxy Internal Lining*

The liquid epoxy internal lining shall have the following properties:

- Electrical non-porosity: Wet sponge: 67,5 V
- Cross adhesion test:

  Level 2 NFA 49709 - Appendix C
- Pull-off adhesion test:

  10 MPa NFA 49709 - Appendix C
- Hardness Shore D:

  > 50
- Bending flexibility: 1% at 23°C
- Immersion test in demineralized water: Class 1 in accordance with ISO 2409.

Tests are performed according to NFA 49709.

2-D-5-8 *Ends Preparation*

Cut-backs are:

- For bevelled pipes:

  50 mm from both ends

- For pipes equipped with lap-joints: 150 mm from the spigot end

  20 mm from the bell end

2-D-6 CEMENT MORTAR INTERNAL LINING

2-D-6-1 Product Standard and Lining Process for Cement Mortar Lining

Cement mortar should be applied using centrifugal spraying process and according to NFA 49701 or DIN 2614 and to the requirements given hereafter. In case of contradiction between standards and the present terms of reference, the requirements of these terms of reference of the present specification prevail.

Fresh mortar is applied using a centrifugal applicator head. The lining is then smoothed and the exceeding water in mortar is expelled by rotating the pipe.

2-D-6-2 Composition of The Cement Mortar Lining

Cement mortar lining should be made of a mixture of cement, sand and water. It shall be suitable for transportation of potable water.

Cement shall be of the CHF type according to NF P 15-301 or equivalent. Cement

mortar shall be composed so that:

- The S/C ratio (mass of sand in terms of mass of cement) is 2.1 (-0 / 10.3).
  When CHF cement is used, S/C can be reduced to 1.6.

The E/C ratio (mass of water in terms of mass of cement) shall not exceed 0.42.

In case of pipes used for sewage application, the cement used for internal lining should be sulphate resistant high alumina (similar to the cement lining for Ductile Iron pipes according to EN 598).

2-D-6-3 Thickness of The Mortar Lining

For high furnace cement, such as the CHF type according to French Standard NF P 15301, the minimum thickness is:

273 mm < OD ≤ 406 mm:	5 mm
406 mm < OD ≤ 610 mm:	6 mm
610 mm ≤ OD ≤ 711 mm:	8 mm
713 mm ≤ OD ≤ 914 mm:	10 mm (OD: outside diameter)

2-D-6-4 Routine Inspection of The Lined Pipes

- Visual inspection: All pipes should be visually inspected.
- Thickness inspection: Thickness should be checked on four pipes per production shift.
- S/C and E/C ratio: two determinations per week of production.
- Mechanical resistance: one test per month of production.
- Granulometric curve of the sand: one check per batch. Tests should be performed
- according to procedures specified in NFA 49701.

2-D-6-5 *Routine testing and inspection*

After a 28-day storage, the minimum mechanical characteristics of the cement mortar are:

- Resistance to compression: 35 MPa.
- Resistance to flexural tension: 5 MPa.

2-D-6-6 *Ends preparation*

Cut-backs are:

- For bevelled pipes:
- 10 mm from both ends
- For pipes equipped with lap-joints:
- No cut-back for the spigot end.

In the bell, cement mortar ends with a rubber ring placed in such a way that the minimum overlapping is achieved.

2-E UPVC PIPES

2-E-1 GENERAL

UPVC pipes and fittings shall comply in all respects with the following standards:

- B.S. 3506 Unplasticized UPVC pipes for industrial uses.
- B.S. 3867 Outside Diameters and Pressure Ratings of Pipe of Plastics Materials.
- B.S. 4514 Unplasticized UPVC Underground Drain Pipe and Fittings.
- B.S. 5481 Unplasticized UPVC Pipe and Fittings for Gravity Sewers.

Approved manufacturers shall supply all pipes and fittings. The nominal length of pipes shall be not less than 6.0 m and not greater than 9.0 m.

UPVC pipes shall be factory tested and shall be subjected to Hydraulic and to Impact (Falling Weight) Tests. The number and selection of samples for testing, the test procedure and the requirements shall all be as specified in the relevant B.S. if so directed by the Engineer. The selection of samples and the Tests shall be witnessed by a representative of the Engineer who shall be informed at least 48 hours in advance of any sampling or testing.

The cost of samples, their transportation to the laboratory, and their testing shall be deemed to be included in the unit rates and shall not be paid for separately.

The diameters measured in mm and indicated on the drawings.

2-E-2 GENERAL PHYSICAL PROPERTIES

Density	1650 kg/m^3 – 1950/m^3
ELASTIC MODULES	
Circumferential flexural	13000 Mpa – 15000 Mp
Circumferential tensile (for pressure pipes)	10000 Mpa – 12000 Mp
Longitudinal tensile and flexural	6000 Mpa 7000 Mpa
MINIMUM ULTIMATE STRAINS	
Circumferential tensile	
Initial	1.4
Long term (50 years)	0.9
Circumferential flexural	
Initial	1.4
Long term (50 years)	0.9

Longitudinal tensile Initial (pressure pipes): 0.4
Initial (non-pressure pipes): 0.3

Poison's ratio: 0.3

THERMAL EXPANSION
Longitudinal direction: 20 x 10-6 per deg. K

Circumferential direction
Non-pressure pipe: 20 x 10-6 per deg. K
Pressure pipe: 15 x 10-6 per deg. K

STIFFNESS

The stiffness of a pipe indicates the ability of the pipe to resist external soil, hydrostatic and traffic loads, and negative internal pressures.

According to British Standard and ISO draft, stiffness is expressed as follows: S = EI / Dm^3

Where S = Pipe stiffness N/M2

E = Modulus of elasticity, Pascal

I = Second moment of area per unit length of the pipe wall Section

In M4 / M

Dm = Mean diameter in M.

2-E-3 HAULING, HANDLING AND STORAGE

Rough handling of pipes shall at all times be avoided, especially at low temperatures. During storage and transport, rigid UPVC pipes shall have as near continuous support as possible at all times, and care shall be taken to avoid damage to pipe by sharp edged angle irons, exposed nail heads, etc.

For long term storage in average ambient temperature, attention shall be paid to stack heights to avoid the possible deformation of the pipe diameters. A maximum height of 1 meter is recommended. For temporary storage on site, care shall be taken to ensure that the ground is level and free front bricks, stones and sharp edges. At high temperatures, rigid UPVC pipes shall be kept in the shade during long term storage. UPVC pipes with spigot and socket shall be stacked with the sockets protruding in alternate layers. Pipes bent, deformed in any way or changed in color shall be rejected and the payment whatsoever shall be made for such pipes.

While transporting, the pipes shall not overhang the vehicle by more than 0.6m. Pipe loads shall not be stacked higher than 2.0 m.

Where pipes are transported one inside another, care shall be taken that:

a. Tile pipes are clean and free from grit.

b. Suitable covering be provided over the exposed ends of the pipes to prevent tile entry of grit during transport.

c. The pipes in the lower layers are not excessively loaded to such a degree as would cause damage or undue distortion.

2-E-4 CUTTING PIPES

Pipes shall be cut with an approved mechanical pipe cutter and in conformity with pipe manufacturer's recommendations. Where the cut end of the pipe is to be incorporated in a joint the pipe shall be turned down to the correct diameter required for forming the joint by an approved mechanical turning machine. The length of turning shall be sufficient to enable the joint to be properly made. The ends of the pipe shall be accurately beveled by mechanical means to the dimensions specified in the manufacturer's recommendations.

The cut end shall be beveled as required to suit the form of joint used.

2-E-5 LAYING AND JOINTING

After the excavation and preparation of a section of pipe trench has been completed, it shall be inspected by the Engineer. Just before pipe-laying the trench shall be cleaned of all stones, soil and other debris that might have fallen therein.

All pipe-laying shall be carried out by experienced pipe-layers, well skilled in this work.

Immediately before being laid, each pipe and fittings shall be carefully examined both inside and outside for any damage, and all dust, dirt and foreign matter shall be removed. Care shall be taken to ensure that they remain clean during laying. The use of a badger will be ordered by the Engineer, if in his opinion, dirt is not being satisfactorily excluded. The badger, on a sound rope, is to remain within the bore of the pipe previously laid and jointed and it is to be drawn forward as the work proceeds throughout the whole length of the sewer. The badger is to be of soft material which will not damage the internal surface of the pipes.

In order to prevent stones and soil from entering the pipe, a suitable cap or plug shall be provided with which the last pipe laid shall be closed when pipe laying is not actually in progress. The plug will be of the screw-up expanding type or of tapered wood.

Where bends are required, performed bends of the desired radii shall be used. Hot bending on site is not permitted.

All joints shall be flexible, with approved rubber rings. Rubber rings shall comply with B.S. 2494 (Elastomeric Joint Rings for Pipework and Pipelines) and shall be of the type designated on the Drawings, or in the Particular Specification, or as directed by the Engineer.

Pipe length and fittings shall be supplied with a chamfer on the spigot end. Where pipes have to be cut to length, the pipe shall be cut square and a chamfer formed on the spigot end using a medium file. Any saw pushing shall be scraped off with a knife. The spigot and socket shall be free from mud or grit, and the ring correctly located in its groove. A lubricant approved by the Engineer shall be applied to the chamfered portion of the spigot before its insertion in the socket.

Pipes shall be laid true to line by means of a line stretched along the sides of the pipes and true to level by means of a straight edge of suitable length kept inside the pipes and pulled forward to pegs boned in at suitable intervals between sight rails set to the proper levels.

2-E-6 MECHANICAL TEST:

Samples of pipes taken from different lots shall be tested in the manufacturer's testing laboratory or any other testing laboratory selected by the engineer/owner and in the presence of representatives of the engineer/owner.

a. The following mechanical tests shall be applied:

1. Resistance to internal hydrostatic pressure. The method for acceptance and quality tests shall be in accordance with ISO 1167.
2. And at least one of the following tests shall be applied:

– Resistance to external blows of UPVC pipes shall be tested in accordance with DIN 3127.

– Tensile characteristics of the pipes shall be tested in accordance with DIN 3504 and DIN 3502.

b. The following physical tests shall be applied:

– Vicar softening temperature shall be tested in accordance with ISO 2507.

– Longitudinal reversion test shall be in accordance with ISO 2505 or DIN 4449.

2-F GRP PIPES

2-F-1 GENERAL

GRP (Glass Reinforced Plastic) pipes shall meet the requirements of the most recent edition of ASTM D 3262 together with the requirements specified herein. GRP pipes and fittings shall be purchased locally provided they conform to these Specifications.

The Contractor shall supply to the Engineer, manufacturer's signed certificates stating that the pipes comply in all respects with the provisions of these Specifications and giving the results of all specified tests.

Other methods for manufacturing of GRP pipes may be proposed but such methods will be subject to the approval of the Engineer. Acceptable alternatives to the filament-wound type of pipe described above include the centrifugally cast type complying with BS 5480 subject to independent evidence of a long record of satisfactory use and subject to the Engineer's approval of the detailed specification.

2-F-2 MATERIALS

2-F-2-1 Appearance

The internal surface of all pipes and fittings shall be smooth, hard, durable and free from all tack, protruding fibers, voids, pits, bubbles, cracks, blisters and foreign matter. The external surface of all pipes and fittings shall be a fiberglass surface mat impregnated with polyester resin and shall be commercially free of resin runs, dry areas, dirt and black marks.

The resin reinforcement and aggregates, when combined as a composite structure, shall produce pipes and fittings that satisfy the performance requirements of these Specifications.

2-F-2-2 Design Requirements

All pipes and joints shall be designed for a minimum working life of 50 years.

Pipelines may run beneath roads and be subjected to maximum loading conditions, therefore, design shall be for the worst surcharge conditions and loading applicable in Lebanon.

The pipe shall be designed to withstand the internal environmental conditions specified below:

pH value: 1 to 13

BOD: up to 1000 mg/l

Suspended solids: up to 1000 mg/l

Chloride: 500 mg/l

Free NH_3: 150 mg/l

Sulphate: 1000 mg/l

Temperature: 5 to 50 °C

Prevailing temperature throughout sewage medium is: 30 °C

Sewage dissolved H_2S: Up to 20 mg/l

H_2S gas concentrations: Up to 2000 mg/l

The ground and groundwater in which the pipes shall be laid are high in salts and are aggressive.

2-F-2-3 Resins

Resins shall comply with the relevant requirements of BS 5480. Details of all resins to be used in the manufacture shall be provided and shall include all the properties listed in the table herein. The resin system adopted shall be that most suitable to the internal and external environmental conditions and resin properties shall be tested in accordance with the following table.

- **RESIN PROPERTIES**

Property	Test Method	Units
Liquid Resin		
- Acid Value	BS 2782, BS 3532	mg KOH/g
- Viscosity at 25 deg C	BS 188 &BS 3532	m Pas
- Specific Gravity	BS 3532	
- Volatiles content	BS 3532 &	BS 2782
- Refractive Index	ASTM	D 1045
Cured Resin		
- Heat distortion temperature	BS 3532 Appendix A	deg C
- Glass transition temperature	Differential thermal analysis	deg C
- Tensile strength	BS 2782	MN/m^2
- Flexural strength	BS 2782 & BS 3532	MN/m^2
- Ultimate elongation	BS 2782	
a.Basic resin		%
b.If flexibilised		%
- Barcol hardness	BS 4549 Appendix A	
- Water absorption	BS 2782 & BS 3532	mg
Information supplied on cured resin shall include details of the cure system employed, which shall be the same as that proposed for manufacture of pipes and fittings.		

2-F-2-4 Fiber Reinforcement

With the exception of a veil on the inside face of the pipe, all fiber reinforcements used shall be of ECR/ADVANTEX type glass and shall comply with the appropriate standard listed below and shall have a surface treatment compatible with the resin.

BS 3691 Glass fiber roving for the reinforcement of polyester and of epoxy resin system.

BS 3496E Glass fiber chopped strand mat for the polyester resin systems BS

3396 Woven glass fiber fabrics for plastic reinforcement

BS 3749 Woven roving fabrics of glass fiber for the reinforcement of polyester resin systems. If a veil is used on the inside face of the pipe, this shall be "C" glass fiber.

2-F-2-5 Aggregates and Fillers

Aggregates and fillers shall comply with the relevant requirements of BS 5480. Silica sand, if used in the manufacture, shall be a minimum of 95% pure silica. The maximum percentage by weight of all aggregates and fillers in the laminate(s) shall not exceed 30%.

No pigment shall be added to any resin used

2-F-2-6 Liner

All pipes and fittings shall have a suitably reinforced resin rich liner to give high corrosion, impact and abrasion resistance. The thickness of this liner shall be determined by the pipe manufacturer, but shall not be less than 1½ mm. No aggregate or fillers shall be included in the liner.

The liner shall consist of two layers, a surface layer and a barrier layer. The surface layer shall be a minimum of 1 mm thick with a minimum of 90% Venylester resin. Any reinforcement in this layer shall be of C type glass or approved suitable synthetic material. The barrier layer shall have 70% to 80% Vinylester resin with ECR/Advantex glass reinforcement.

2-F-2-7 *Structural Design*

Details of loading and pressures shall be as shown on the drawings. Pipes and fittings shall be designed to these standards for the ground conditions to be encountered. All pipes and fittings shall have a minimum stiffness of 5000 N/m² to accommodate handling and transportation stresses unless specified otherwise.

For buried pipes stiffness shall depend upon depth of cover above the crown of the buried pipe in accordance with the following:

For depths of cover over the pipe more than 6.0 meters or less than 1.5 meters, pipe stiffness shall be minimum 10000 N/m². For depth of cover more than 1.5 m and less than 6.0 meters, pipe stiffness shall be minimum 5000 N/m².

Note: Stiffness factor 'F' shall be calculated as follows:

$$F = \frac{EI}{d^3}$$

where, E = Flexural modulus of elasticity of pipe material in circumferential direction.

$$I = \frac{S^3}{12}$$

S = Wall thickness (m)

d = Mean pipe diameter (m)

Pipe shall have an initial ultimate resistance to longitudinal tensile force per unit of circumference of not less than the following:

DIAMETERS	RESISTANCE
Up to and including DN 600	150 N/mm²
Greater than DN 600 up to and including DN 1200	200 N/mm²
Greater than DN 1200 up to and including DN 2400	250 N/mm²

2-F-2-8 *Sizes and Tolerances*

2-F-2-8-1 *Diameter*

The diameter of the pipe shall be designated by the nominal internal diameter. The manufacturing tolerance of the internal diameter shall be in accordance with BS 5480.

All deviations from roundness, with the exception of pipe deformation due to its own weight, shall be contained within the tolerances. Deviations in diameter of spigot and sockets shall be kept to the absolute minimum and shall be such that the seal at the joints is not affected.

2-F-2-8-2 *Length*

Effective length of pipes and tolerance on effective length shall be as specified in BS 5480.

Where it is found necessary to cut or turn down a pipe in order to form a joint, the exposed surfaces shall be fully sealed with a continuous coating of fully cured resin.

2-F-2-8-3 *Wall Thickness*

Wall thickness shall be as recommended by the pipe manufacturer and to the approval of the Engineer.

2-F-2-9 *Fittings*

All fittings and collars such as bends, tees, junctions and reducers shall be equal to or superior in performance to pipes of the same classification and shall comply with BS 5480.

The use of metals for any part of these fittings will not be permitted. However, the Engineer may allow the use of fittings of other materials which are commonly used in the construction of sanitary sewers, provided that the design of fittings and pipes are mutually compatible.

2-F-2-10 *Joints and Gaskets*

Joints shall be of the collar type incorporating rubber rings. All joints shall be capable of withstanding the various tests specified for the appropriate class of pipe and shall withstand a deflection of not less than 1½ degrees in any direction while maintaining the specified test pressures.

Minimum requirements for the rubber rings shall be as specified in BS 2494. Gaskets shall be of a thickness and design to provide watertight joints. The joints shall be qualified before installation with full testing according to ASTM D 4161. At least one test shall be carried out for each diameter. The Contractor shall ensure that the joint gaskets and joint ring are suitable for use in the prevailing climatic soil, ground water and sewage conditions.

All rubber rings shall be of the type that can pass an acid aging test as directed by the Engineer without any noticeable deterioration in the mechanical or chemical properties of the material used.

Flanged pipes shall incorporate an annular gasket at the joints. The gaskets shall cover the full face of the flanging and shall have holes cut in them corresponding to the bolt holes in the flanges. Alternative forms of gasket may be used, subject to the approval of the Engineer. Flanges shall be drilled to BS 4504, metric units, Type PN16.

2-F-2-11 *Testing*

2-F-2-11-1 *Raw Materials*

a. Resins

All deliveries of resin shall be checked for consistency by viscosity and reactivity and refractive indices. Resins deviating from these Specifications shall not be used.

b. Glass

All deliveries of glass shall be checked for consistency by dry strength and chemical resistance to 1.0 N sulphuric acid. Pipes shall only be manufactured from batches of glass

exhibiting similar strength and chemical resistant properties. Should these properties change due to variations in suppliers, the pipes produced from this glass shall be tested in accordance with the strain corrosion test as if they were different diameter or class. The Engineer may accept test reports of ECR glass as supplied by the manufacturer and testing of pipe factor glass may be dispensed with.

c. *Sand or Aggregate*

All deliveries of sand or aggregate shall be checked for consistency of grading, moisture content and purity.

2-F-2-11-2 Manufactured Pipe

a. *Strain corrosion Test*

Control testing shall be carried out during the manufacture of pipes in accordance with Section 6.3 of ASTM D 3262 using the specified test solution. Control tests shall be carried out for each diameter and class of pipe.

In the event regression curves are not available or any changes to the pipe wall and laminate build-up and/or the properties of the raw materials at any time during the manufacture of the pipes, two complete sets of corrosion tests (including a regression curve) shall be carried out in accordance with ASTM D 3681. One set shall use a 10% W/W solution of sulphuric acid maintained at a temperature of 25°C ± 1 C. The other set shall use a 5% W/W solution of sulphuric acid maintained at a temperature of 23 °C.

Strain corrosion tests shall be run on a minimum of 6 samples from each lot of pipe diameter to ensure that they fall above the regression curve values defined by the manufacturer.

b. *Hydraulic Tests in Factory*

All pipes shall be subjected to an internal hydraulic pressure test at the manufacturer's plant prior to delivery. The test shall be applied to a pressure equal to two times the working pressure or 6 bars of water head whichever is higher. The test pressure shall be applied for a minimum period of 5 minutes without signs of leakage.

All fittings shall be subject to an internal low-pressure test at the manufacturer's plant prior to delivery. The pressure test shall be carried out at 0.1 bar and shall be applied for a minimum period of 5 minutes without signs of leakage or distress. Fittings of metric construction shall be manufactured from pipe which has successfully passed the tests defined above.

c. *Stiffness*

A minimum of one pipe in every 30 pipes, one per shift, or one per production run, whichever is less, shall be tested for stiffness in accordance with ASTM D 2412 "Test for External Loading Properties of Plastic Pipe by Parallel Plate Loading". A minimum of one pipe for each size shall be tested.

d. *Longitudinal Tensile Strength*

For pipes with internal diameters of 600 mm and less, a minimum of one pipe in every 1000 pipes manufactured shall undergo a beam test in accordance with ASTM D 3262, Section 8. A minimum of one pipe for each size shall be tested.

e. *Coring/Hardness Test*

All manufactured pipes shall be subjected to both a Barcol Hardness Test in accordance with BS 4549, Part 1, Appendix A and a commercial acetone test. Both tests shall be carried out on internal and external pipe surfaces.

f. *Loss on Ignition*

A minimum of one pipe for every 30 pipes, one per shift, or one per production run, whichever is less, shall be tested in accordance with ASTM D 2584. From each test pipe, two samples shall be taken for test.

One sample shall comprise the complete laminate including the liner. The second sample shall comprise the laminate without the liner and shall be split off at the interface between the liner and the structural wall.

g. *Other Test and Compilation of Data*

Quality control testing shall include thorough checks of all materials to ensure that they comply with the relevant standards and requirements of the Specifications. All pipes and fittings shall also be subject to a complete visual inspection before shipment. Records of all tests and inspections shall be maintained by the manufacturer and two copies of all test certificates shall be forwarded to the Engineer.

In addition, the Contractor shall submit all necessary data and manufacturer's specifications of the GRP pipes and joints, including details of raw materials, pipe design, manufacturing process, laying instructions and all other relevant information required by the Engineer.

h. *Test Failure*

In the event of a pipe failing the strain corrosion test, two more tests shall be performed: one on a pipe from the previous five pipes and one on a pipe from following five pipes, if any of these two pipes fails, all pipes of that diameter and class which have been manufactured shall be rejected and shall be replaced entirely at the Contractor's expense.

Pipe failing any other test shall be rejected and an additional ten pipes shall then be tested. Five of these pipes shall have been sequentially produced immediately prior to the failed pipe and five immediately following. If anyone of these ten pipes fails, then every pipe shall be tested. Only pipes passing the tests will be accepted.

All pipes and fittings will be subjected to a visual inspection by the Engineer after offloading at Site. All pipes and fittings that have been damaged during delivery shall be repaired and/or replaced by the Contractor and the pipe shall be subject to a further hydraulic test to be carried out by the Contractor as specified herein. Such making good and hydraulic testing at site shall be entirely at the Contractor's expense.

i. *Marking and Identification*

All pipes, including cut lengths and fittings shall be indelibly marked prior to delivery in the order given below with:

i) The manufacturer's name, initials, or identification mark

ii) The nominal internal diameter in mm

iii) The classification, i.e. pressure rating, stiffness (to avoid confusion, pipe rated at 2.5 or 12.5 bars shall be marked 2½ or 12½ and not 2.5 or 12.5).

iv) The date of manufacture.

v) A suitable stamp to indicate that the pipe has satisfactorily passed the required inspection and hydraulic tests at the manufacturer's plant.

These markings may be arranged either in one line or in several lines provided that the order is preserved.

j. *Third Party Inspection*

All tests shall be supervised and certified by a third party inspection agency approved by the Engineer. All costs for the inspection agency shall be borne by the Contractor and shall be included in the cost of the pipe.

All pipes shall be visually inspected on site prior to installation. The pipes shall be free of defects such as delaminating, air bubbles, protruding or exposed fibers, cracks, air holes, surfaces non-impregnated with resin which can affect, due to their extent, the rigidity and usefulness of the pipe. Defects extent shall be defined by Manufacturer and approved by the Engineer.

The surface of the pipe joints shall be free of all defects and surface irregularities that can affect their integrity. All repairs effected on site shall be agreed to by the Engineer and conducted by qualified personnel from the pipe manufacturer.

2-F-2-12 *Loading, Unloading and Transportation of Pipes*

GRP pipes are made of delicate elastic materials and, therefore, require special care in loading, unloading and other handling. Nylon lifting strings shall be used for loading and unloading of pipes. Pipes shall not overhang trucks or trailers while being transported and shall be securely tied. Avoid sudden drops or motion while loading and unloading.

2-F-2-13 *Storing Pipes, Fittings and Accessories*

Pipes shall be stored on flat ground having no stones or debris to prevent any damage to the pipe barrel. It is advantageous to store pipes on timber pieces to facilitate placement and removal of lifting strings. Storage of pipes in heights over 2m shall be avoided. All pipes shall be properly secured to prevent rolling in high winds.

Rubber ring gaskets shall be stored in the shade in the original packing. The store shall be air-conditioner during summer. Gaskets shall be protected from exposure to greases, oils, solvents, or any other petroleum derivatives or chemicals.

Gasket lubricant shall be carefully stored to avoid damage to the container. Partially used buckets shall be properly resealed to prevent contamination of the lubricant. If the lubricant is contaminated by any foreign substance, it shall be abandoned.

2-G TEST OF DISINFECTION OF POTABLE WATER PIPES AND RESERVOIRS

Provide equipment, gauges, temporary connections, chlorine and water needed for flushing and disinfection after all work has been completed.

Before commencing disinfection, flush main until effluent is clean and then clean as directed by the Engineer. 1 to 2 times volume of pipe is usually required for such flushing.

After closing all pipeline's exit, the Contractor shall fill pipelines with clean water mixed with chlorine dose of 20 mg per liter. Wait for 24 hours, then measure residual chlorine by taking a sample to the lab and perform a bacteriological test in the presence of the Engineer. If any

harmful signs appear, disinfection process must be redone and another test must be taken until the test gives a result acceptable to the Engineer.

After the completion of the work, the Contractor must fill the reservoirs with clear water mixed with chlorine dose of 20 mg per liter and,

1- Wait for 24 hours, then measure residual chlorine by taking a sample to the lab and perform a bacteriological test in the presence of the Engineer. If any harmful signs appear, disinfection process must be redone and another sample must be taken until the test gives a result acceptable to the Engineer.

2- Wait for an additional 48 hours and check if the water level stays as it was. If not, the Contractor has to fix the reservoirs on his own expense and restart the test

The cost of these tests is considered to be included in the unit rates of the materials and works related to the pipes and reservoirs mentioned in the Bill of Quantities.

2-H FINAL CLEANING AND INSPECTION

Before the works are accepted by the Engineer, the entire pipe system, including all structures, shall be thoroughly cleaned by flushing or by passing a brush, sphere or other suitable tool through it, or by any other approved method, to ensure that it is clean, and free of obstructions and that pipe runs are perfectly straight. Before taking over, the pipeline will be finally inspected by the Engineer.

2-I ACCESSORIES

Refer to Part IV- MECHANICAL WORKS.

Part III: Civil Works

Part III-1: EARTHWORK

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PART 3.1 - CIVIL WORKS: EARTHWORK

3-1-A EARTHWORK (GENERAL)

3-1-A-1 DESCRIPTION

This work shall consist of clearing and grubbing, stripping, removal of unsuitable soil, excavation, fill and backfill, and other specified works related to the earthwork.

3-1-A-2 GENERAL REQUIREMENTS

Prior to any excavation in the streets, a license request together with all detailed drawings showing the locations of the excavations and a written commitment to restore the street to its initial condition shall be submitted to the Engineer.

Excavation in streets and roads shall not commence without written approval from the Engineer.

Before the commencement of any earthworks or demolition the sites shall be surveyed as necessary in conjunction with the Engineer's representative to establish existing ground levels.

The Contractor shall not start any earthwork before getting the Engineer's approval on the cross sections.

The Contractor shall correct all disapproved cross sections and resubmit them for approval. The

Contractor shall excavate, refill and restore in advance of his program such trial holes as he may require for determining the nature of the subsoil and the location of existing underground services and obstructions.

The Contractor shall ensure that there are no pipes, cables, mains or other services or property which may be disturbed or damaged by its use. He will take all precautions not to damage these services and restore these services if damaged on his own expense.

3-1-A-2-1 Explosives

The Contractor shall at all times take every possible precaution and comply with the Explosives Laws of Lebanon and regulations relating to the handling, transporting, storing and use of explosives and shall at all times when engaged in blasting operations post sufficient warning flagmen to the full satisfaction of the Engineer's Representative. The Contractor shall also provide a special proper store for explosives in accordance with local regulations and shall provide experienced men with valid blasting licenses for handling explosives to the satisfaction of the Engineer and the authorities concerned.
The Contractor shall at all times make full liaison with and inform well in advance and obtain such supervision and permission as is required from the Police and all Government Authorities, public bodies and private parties whosoever concerned or affected by blasting operations.

Blasting shall only be carried out on those sections of the Works for which permission in writing shall have been given by the Engineer and the relevant authorities and shall be restricted to such hours and conditions as may be prescribed. Blasting within 10 meters of existing water mains will not be permitted.

Blasting shall be carried out so as not to weaken an existing structure or the foundations or ground adjacent to the existing and proposed works. The Contractor shall take all necessary precautions to prevent loss injury or accident to persons or property and shall be entirely liable for any accident or damage that may result from the use of explosives.

The Contractor shall submit to the Engineer for his approval a method statement including details of the intended drilling patterns, depths of holes, the amounts of explosives at each location, and the method or sequence of setting off what he proposes to use.

3-1-A-2-3 Clearing & Grubbing

3-1-A-2-3-1 Description

This work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits specified. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

3-1-A-2-3-2 General Requirements

The areas to be cleared and grubbed shall be as shown on the Plans, as designated in the Specifications or as directed by the Engineer. The Engineer will designate all trees, shrubs, plants and other things to remain. The Contractor shall preserve all things designated to remain.

Before carrying out work, the Site shall be inspected by the Contractor in conjunction with the Engineer to establish its general condition which shall be agreed and recorded in writing, and where in the opinion of the Engineer it is deemed necessary, by means of photography.

Details recorded shall include the location of all boundary and survey beacons, the condition of buildings, surfaces terracing (if any), ditches, watercourses roads, tracks, fences, and other information relating to the Site and elsewhere which may be affected by the works.

In the case of wayleaves for pipelines, the boundaries of the wayleave will be defined by the Employer and the Contractor shall provide, erect, and maintain in position from commencement to final completion of the Works, in every section substantial timber stake or similar approved markers not less than 1.5m high indicating the position of the boundary at 50m or other such intervals as the Engineer may direct. In the event of any boundary or survey mark established for the purpose of land title being disturbed or displaced, the Contractor shall forthwith replace the beacon. Where necessary the Contractor shall employ the services of an approved licensed surveyor for the purpose of setting out boundaries.

Before beginning clearance in any area, the Contractor shall give seven days written notice of his intention to the Engineer who will determine the extent and limits of such clearance.

All surface objects and all trees, stumps, roots, sod and vegetable matter, other protruding obstructions, not designated to remain shall be cleared and grubbed.

Within the limits of clearing and grubbing, all stumps, roots 4 cm in diameter or larger, buried logs, and all other objectionable material shall be removed 90 cm below the existing ground surface or subgrade, whichever is deeper.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted to 90% of Maximum Dry Density.

Topsoil shall mean the surface layer of soil which by its humus content supports vegetation and is unsuitable, as a formation to roads and concrete structures or as a backfill or bedding material. The extent and depth of topsoil that needs removal shall be agreed with the Engineer.

Topsoil shall be set aside for re-use or disposal off site as directed by the Engineer.

Trees to be removed shall be uprooted or cut down as near to the ground level as possible. Bushes, undergrowth, small trees, stumps and tree roots shall, where directed by the Engineer, be grubbed out. All holes left by the stumps or roots shall to backfilled with suitable material in a manner approved by the Engineer.

Materials arising out of site clearance shall be disposed by the Contractor off the Site, or where approved by the Engineer on the Site in a manner and place approved by the Engineer.

The Engineer may require that individual trees, shrubs and hedges are preserved and the Contractor shall take all necessary precautions to prevent their damage.

In the case of wayleaves for pipelines and the like, the Contractor shall preserve as far as practicable all grass and other vegetation outside the limits of trenches and permanent works and shall not unnecessarily destroy crops or any vegetation whose removal would not be essential to his operations.

The Contractor shall take care at all times to prevent erosion on every site and elsewhere on land which may be affected by his operations and the Engineer may impose such reasonable limitations and restrictions upon the method of clearance and upon the timing and season of the year when clearance is carried out as the circumstances warrant.

3-1-B EXCAVATION

3-1-B-1 EXCAVATION IN GENERAL

3-1-B-1-1 Description

This work shall consist of all excavation for structures, chutes, canals, pipelines, trenches, culverts, headwalls, basins, gravel traps, manholes, inlets, retaining walls, roadways and other specified works.

3-1-B-1-2 Classification

All excavation will be classified as one of the following:

- Common Excavation Common excavation consists of the excavation and disposal of all materials of whatever character encountered in the work except rock.
- Rock Excavation Rock is defined as a sound and solid mass, layer, or ledge of mineral matter in place and of such hardness and texture that it cannot be effectively loosened or broken down by ripping in a single pass with a late model tractor-mounted hydraulic ripper equipped with one digging point of standard manufacturer's design adequately sized for use with and propelled by a crawler-type tractor rated between 385 and 410 net flywheel horsepower operating in low gear.

In areas where the use of the ripper described above is impracticable, rock is defined as sound material of such hardness and texture that it cannot be loosened or broken down by a manual drifting pick.

Boulders and detached stones having a volume of 0.75 cubic meters or more shall be classified as rock.

- Unclassified Excavation "Unclassified Excavation" shall be that volume of excavation consisting of the removal of all materials regardless of their physical properties.

3-1-B-1-3 General Requirements

Excavation in public streets is subject to the following:

- Decree-law No. 68 dated 9/9/1989
- Decree-law No. 98 dated 9/9/1989
- Circular issued by the Prime Minister's Office No. 6/95 dated 13/3/1995

Excavation shall be made in open cutting unless tunneling or heading is specified or approved by the Engineer and shall be taken out as nearly as possible to exact dimensions and levels so that the minimum of infilling will afterwards be necessary.

The Contractor shall ensure the stability and safety of excavations and shall take all measures necessary to ensure that no collapse or subsidence occurs.

Except where described in the Contract or permitted under the Contract excavation shall not be battered. The sides of all excavations shall be kept true and shall where necessary be adequately supported by means of timber, steel or other type struts, walings, poling boards, sheeting, bracing, and the like. Supporting excavation cost shall be deemed included in the excavation unit rate.

Excavations shall be kept free from water and it shall be the Contractor's responsibility to construct and maintain temporary diversion and drainage works and to carry out pumping and to take all measures necessary to comply with this requirement.

3-1-B-1-3-1 Excavation in Excess

In the event of unsuitable ground being encountered at formation level or if the formation is damaged or allowed to deteriorate, the Contractor shall forthwith inform the Engineer. The Contractor shall excavate to such extra depth and refill with compacted granular or other approved fill or Class D concrete as the Engineer may require. With respect to the side face of any excavation against which concrete or other work will be in contact the Engineer may require that the net dimensions of the work be increased.

If any part of any excavation is in error excavated deeper and/ or wider than what is required, the extra depth and/or width shall be filled with Class D concrete or compacted granular or other approved fill to the original formation level and/or dimensions as the Engineer directs on the contractor's expense.

In pipe trenches where the pipe is not bedded on or surrounded with concrete, excess excavation shall be filled with compacted granular material. Excess excavation in rock trenches shall be filled with Class D concrete up to 100 mm below the pipe invert.

3-1-B-1-3-2 Excavated Materials Suitable for Re-use

No excavated material suitable for re-use shall be removed without the approval of the Engineer.

During excavation, the Contractor shall ensure that all material suitable for re-use are kept separate and set aside and protected as necessary to prevent loss or deterioration.

The materials forming the surface and foundations of roads, road verges, tracks and footways shall when excavated, and if required for further use, be carefully separated. All hard materials shall be kept free from soil or other excavated materials.

During excavation, the Contractor shall ensure that all granular or other approved material suitable for filling around and over pipes shall be kept separate and re-used for this purpose.

Paving slabs, bricks and similar surfaces shall be carefully removed and stacked. Prior to the commencement of excavation, the number of badly broken and unsuitable paving slabs, bricks etc. on the line of the excavation shall be agreed with the Engineer.

In verges and other grass surfaces the grass and top soil shall be stripped and separately stacked.

3-1-B-1-3-3 Damages Caused to the Surface of Roads

Where the surface of the road damaged either by the concentration of traffic caused by an open excavation, by subsidence or other causes arising from the operations of the Contractor. The Contractor shall permanently reinstate the whole of the surface to its original condition.

3-1-B-1-3-4 Safety of Excavations

The Contractor shall ensure that excavation and reinstatement are maintained in a safe condition and shall take immediate action to remedy any deterioration which renders the works unsafe. If in the opinion of the Engineer any excavation or reinstatement is in a dangerous condition the Contractor shall immediately remedy the defect. Should the contractor fail to carry at the reinstatement promptly, the work may be carried out by others at the Contractor's expense.

3-1-B-1-3-5 Mechanical Excavation

Mechanical excavation shall be employed only if the subsoil is suitable and only in such manner which will allow adequate support of the equipment.

3-1-B-2 EXCAVATION FOR SURUCTURES

3-1-B-2-1 Description

This work shall consist of all excavation for structures, gravel traps, chutes, basins, culverts, headwalls, manholes, inlets, retaining walls or other structures, and other excavation for structures.

3-1-B-2-2 *General Requirements*

The Contractor shall notify the Engineer a sufficient time in advance of the beginning of any excavation for structures which so that the Engineer may observe the cross-sectional elevations and measurements taken of the existing ground and structure. Any materials removed or excavated before these measurements have been taken and approved by the Engineer will not be paid for.

The foundation shall be excavated to the outlines of the footings as shown on the Plans or as required by the Engineer and shall be of sufficient size to permit the placing of the full width and lengths of the footings shown with full horizontal beds. Rounded or undercut corners and edges of footing will not be permitted.

The excavation shall be carried out to the elevation shown on the plans or as established by the Engineer. No concrete shall be poured prior to the approval of the excavation by the Engineer. Overdepth excavation below the footing elevation approved by the Engineer and overwidth excavation beyond the lateral limits for footings shown on the Plans or directed by the Engineer, shall be backfilled with the same class of concrete designated for the footing and shall be poured monolithically with the footing. No payments will be made for unauthorized overdepth and overwidth excavation and the concrete backfill shall be at the Contractor's expense.

Where rock bottom is secured the excavation shall be done in such manner as to allow the solid rock to be exposed and prepared in horizontal beds or properly serrated for receiving the concrete. All loose and disintegrated rock and thin strata shall be removed.

Where unstable material or other unsuitable material is encountered below foundation elevation of reinforced concrete structures, the Contractor, at the direction of the Engineer, shall excavate such unstable material and replace with suitable and stable backfill material or blinding concrete as shown on the Plans or directed by the Engineer. The foundation stabilization, necessary depth of excavation and suitability of the proposed backfill material shall be approved by the Engineer prior to the Work.

Suitable and practically watertight cofferdams, or other watertight equipment and materials to maintain a waterfree excavation shall be used whenever water-bearing strata are encountered above the elevation of the bottom of the excavation. They shall be sufficiently large to give easy access to all parts of the foundation form and shall be of dimensions not less than those for which payment for excavation is made and shall be deemed included in the excavation price.

If cofferdams have to be used, then cofferdams shall be constructed so as to keep the excavations free from earth, water, ice, or snow and to permit the excavations to be carried to depths up to 1m below the foundation elevations shown on the plans. They shall be substantially braced in all directions, and of such construction as will permit them to be pumped free of water, and kept free until the concrete has been placed. They shall be such that leakage can be kept out of the concrete or masonry. Unless otherwise shown on the plans or agreed upon with the Engineer, cofferdams and all sheeting or bracing shall be removed after the completion of the concrete or masonry. When the bottom is of sandy or porous material which will not, in the opinion of the Engineer, permit the footing to be poured in the dry, it shall be sealed with concrete so that it may be pumped dry. The cement content water / cement ratio and the maximum coarse aggregate size will be submitted to the Engineer prior to the work. A seal course shall not be used unless shown on the Plans or authorized in writing by the Engineer. If in the opinion of the Engineer, the necessity for a seal course is due to inadequate or improper cofferdam construction, he may order the removal and/or reconstruction of the cofferdam, or permit the placing of a seal course at the Contractor's expense. Other satisfactory methods of sealing out the water may be approved.

After the seal course has set, the cofferdam shall be cleared of water and the work completed in the dry. When weighted cribs are employed and the weight utilized to overcome partially the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation

seal. Cofferdams shall be constructed so as to protect green concrete against the damage from a sudden rising of the stream and to prevent damage to the foundation by erosion.

The provision of dewatering equipment and all operations required to maintain a water free excavation shall be carried out and considered subsidiary to the items of structural excavation.

Maintenance of natural waterways and allowance for the passage of surface water during construction is the Contractor's responsibility and any damage occurring in this respect shall be corrected at the Contractor's expense.

3-1-B-2-2-1 Excavation for Foundations of Structures

The Contractor shall give sufficient notice and sufficient time in advance to the Engineer to enable him to inspect and approve foundations in advance of placement of the permanent work. The Engineer may withdraw his approval if work is not commenced within 48 hours or the formation is subsequently allowed to deteriorate.

If the Engineer directs it, a bottom layer of excavation of not less than 75mm thickness shall be left undisturbed and subsequently taken out by hand immediately before concrete or other work is placed. Where concrete or other materials is to be placed in contact with the side face of an excavation the Contractor shall, where Engineer directs, excavate the last 75mm thickness of the face immediately before the concrete is placed.

Formations which are to receive concrete blinding or a drainage layer shall be covered with such blinding or layer immediately the excavation has been completed, inspected and approved by the Engineer.

Surfaces against which permanent works are to be placed shall be kept free of oil, water, mud or any material.

No concrete or other materials shall be placed until formations have been approved. Adequate notice shall be given to the Engineer to enable him to examine the formation.

3-1-B-2-2-3 Rock Surfaces Under Concrete Structures

3-1-B-2-2-3-1 Concrete Placed Directly on Rock

Rock under concrete structures shall be prepared by picking, barring, and wedging or other methods which will lease the rock in as sound a condition as may reasonably be expected according to the rock quality.

Rock surfaces shall be thoroughly cleaned by compressed air and water jet or such means as the Engineer may direct before concrete is placed.

3-1-B-2-2-3-2 Concrete Placed on Capping Layer

Where instructed the excavation shall be taken down to a depth of 1.0 m below the underside of the structure and the excavation backfilled with capping materials to the required formation level.

Capping material shall be an approved granular material.

The material shall be compacted in 150mm layers to achieve a density of not less than 95% maximum dry density determined by the Moisture - Density curve of the material.

3-1-B-3 EXCAVATION FOR PIPE TRENCHES

3-1-B-3-1 Description

This work shall consist of excavation for pipes laying to the required line and grade.

3-1-B-3-2 General Requirements

Pipe trenches shall be excavated to the typical cross-sections shown on the Drawings, and in no case shall the trench width up to the level specified exceed that shown on the Drawings. The Contractor shall ensure that at any point the width of the pipe trench is sufficient to permit the pipeline to be laid, jointed, bedded/surrounded and backfilling to be placed and compacted around the pipeline to the Engineer's satisfaction. The minimum trench width for each trench type shall be computed according to the data given on drawings.

In order to ensure a rapid execution, a mechanical crane or shovel is necessary to avoid a major disturbance in the road traffic.

The trench invert level and the trench width shall, at any location, be at the proper level and trench width of the proper dimensions to allow for sand and/or concrete bedding or surrounds as shown on the Drawings and directed by the Engineer.

If required by the Engineer, the extraction of backfill materials by means of mechanical engines shall be stopped at a level higher than that of the determined excavation bottom. As for internal walls, the mechanical digging shall stop before reaching the limits of the outline, so as to prevent the engine claws from breaking up the bottom and the walls. The excavation shall then be completed by manual means. The bottom of the trench shall be well levelled and have its longitudinal profile parallel to the pipe.

Where welding or jointing of pipes and/or accessories is required to be done in the trench, the same shall be widened and/or deepened to form bell-holes of sufficient size as directed by the Engineer's Representative so as to easily permit the proper execution of all welding, connecting and fixing works in all their stages, all necessary repairs to the pipe and coating, and for the thorough inspection of all these operations.

The length of trench to be kept open at one time shall be determined by the Engineer and shall in no case be exceeded. The maximum length of open trench shall be 150 meters or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is the greater. Should there by any danger that trenches may erode, then sections shall be left unexcavated for as long as possible and the laying and backfilling of pipelines shall follow excavation as soon as possible.

The excavated material shall be placed alongside the trench (at least 500 mm away from the trench edge) in such a manner as not to interfere with the work and to prevent its falling into same.

Should any part of a trench be excavated, in error, deeper than required, the extra depth shall be filled up with concrete, solely at the Contractor's expense.

Trench formations shall be in undisturbed ground. Where in the opinion of the Engineer, the formation is unsuitable for bearing, extra excavation shall be carried out under the direction of the Engineer and the level made up again with sound soil material carefully compacted or with concrete. This work shall be paid for by the Employer provided that the unsuitability of the formation is not due to the method of working of the Contractor, in which case the Contractor shall carry out the work at his own expense.

In confined areas, where the passage of excavating equipment is impossible, or where the Engineer's Representative deems the use of such equipment impracticable or undesirable for any

reason whatsoever, trench excavation shall be done by hand. All requirements specified above shall apply to trench excavation by hand. No extra payment shall be made for works in confined areas. All excavation, whether in confined or unconfined areas, shall be paid for at uniform rates as specified hereafter.

If, in the opinion of the Engineer, there is undue delay in testing the pipelines; removing surplus material; general tidying up of areas where pipes have been laid; partial restoration of maintenance of surfaces; or similar operations, then the Engineer may order that no further trenches shall be opened until the outstanding work has been carried out to his satisfaction and the Contractor shall have no ground for a claim against the Employer on this account.

No work will be started on the laying of pipes or bedding in any section of trench, until the trench formation of that particular section has been approved by the Engineer.

Once the pipeline section has been tested and the bedding and surround approved by the Engineer, the trenches shall be backfilled by layers as specified hereafter. Each layer shall be separately compacted and any subsidence resulting from insufficient compaction shall be the Contractor's liability and he shall forthwith add the necessary extra material which shall then be thoroughly compacted.

Unless otherwise specified, items for trench excavation shall apply to all kinds of soil, including rock, and the excavation will be measured for payment in linear metres measured along the centreline of the pipeline. The cost of trench excavation shall be deemed to include for excavation, drilling and blasting, to the required width and depth to underside of pipe barrel, finishing the trench bottom as specified by removing unstable materials (rock, boulders and hard spots), digging borcholes where required, removing excavated material and storing it alongside the trench for backfilling whenever permitted, removal of material that may result from land slides, removal of loosened earth or rock, removal and disposal of all excess spoil to any distance, supporting and stabilizing trench walls either by timbering or shoring, dewatering as and where required if no specific items have been provided in the Bill of Quantities.

3-1-B-3-3 Dumping of backfill materials

Backfill materials shall be directly transported by trucks outside the site and discharged at locations approved by the Engineer. The road shall be thoroughly cleared from any backfill material.

As for roads maintained by the municipality, having favorable width and condition, backfill materials could be placed, upon the prior approval of the Engineer, on both sides of the trench; the blocks and stones close to the sidewalk, the sand and the earth free from stones next to the road center line, so as not to impede the traffic.

3-1-B-3-4 Precautions relating to other utilities

The contractor shall take all necessary precautions to protect the installations in the trench.

In order to choose a good location for the installations, the contractor shall use a device to detect the cables before digging trenches, or dig by hand, probing holes at his own expenses.

During excavation works, if the contractor notices a slight water leak from existing pipes he shall immediately notify the Engineer and the competent authorities.

If he encounters electrical or telephone cables or other pipe works, he shall take necessary measures to protect them. The contractor remains entirely responsible before competent authorities for eventual damages.

The contractor shall not demolish, remove or repair any other utility (rainwater pipes, telephone cables, etc.) existing in the trench, but in the presence of the Engineer and the competent authority or upon their approval.

In case these damages occur (breaking of a water pipe, telephone cable, electrical cable, drain pipe, etc.), the contractor is bound to repair them immediately at his own expense (providing materials and labor).

3-1-B-3-5 Water drainage

The contractor shall effectively have at his disposal from the beginning of works all necessary equipment to avoid any water flow and ensure a good drainage.

The excavations shall be kept dry during the works period and eventually during the period the Engineer deems necessary.

Water encountered in the excavations, whether resulting from aquifers or any kind of infiltration, shall be drained towards sumps and then discharged by the contractor.

When pumping water from the excavation, the contractor shall take all necessary measures to prevent soil erosion and undermining, as well as necessary measures to maintain the structures' stability.

The contractor shall be responsible for any damage caused by water to foundations or works. He shall afford any eventual repair.

3-1-C NATURE AND ORIGIN OF THE MATERIALS

3-1-C-1 GENERAL REQUIREMENTS

The materials intended for the construction of the various work, will be supplied by the Contractor and will come from extraction sites that will have to be accepted by the Engineer and must comply with the Technical Specifications.

The approval of the Engineer does not relieve the Contractor from his responsibility as to the quality of materials furnished to the site.

Any change as to the source of the material will have to be approved by the Engineer. Furthermore, the Engineer has the right during the works, to ask for a change of source in the event the quality is not in compliance with the present specifications.

All material must satisfy the French Standard AFNOR and DTU documents, American Standards ASTM or British Standards BS.

3-1-C-2 GENERAL POINTS ON THE QUARRIES

The limestone quarries must be homogeneous, joint free with convenient stratification and little bedding to obtain material of the required quality.

The Engineer will accept or refuse the quarries in a period of 15 days following the Contractor's request. The Contractor must, at his own expense carry out several drillings and trenches that will enable the Engineer to appreciate the quality of the proposed materials.

The cost of searching for a quarry deposit and testing it shall be on the expenses of the Contractor.

If during the works, the excavated material no longer conforms to the required quality, or if the volume of the usable proportion is insufficient, the Contractor must, at his own expense, search for other sites conforming to the specifications.

3-1-C-3 QUALITY AND PREPARATION OF BORROWED MATERIALS

3-1-C-3-1 Norms

All materials shall satisfy with AFNOR, DIN, ASTM or BS norms.

3-1-C-3-2 Material Gradation

- **Material of sand and limestone quarries:**

  The filter material shall be obtained by sieving natural sand in provenance from the sand quarries. The drain material shall be obtained by crushing rocks in provenance from the quarries. These materials shall have a continuous gradation.

- In case of filter and drain materials acting as protection against washing of another material, they shall respect the following conditions:

  1- $\frac{d_{15F}}{d_{85M}} < 5$ F for the filter or the drain M

  for the material to protect

  Note: in case of fine granular soil, this criterion is not valid for filter material. The gradation of filter materials shall be between 0 and 5 mm.

  - $2 < \frac{d_{50}}{d_{10}} < 8$

- Less than 5% of elements < 80 microns and d16 (sand) > 0.1 mm.

- In case of a draining material, the gradation should range between from 1 to 4 cm and less than 5% of elements < 80 microns.

3-1-C-3-3 Rockfill paving, Rockfill, Drain and Filter Materials

Rockfill, drains and filter materials must have sufficient hardness to be discharged in bulk and manipulated by power machines without being broken or disintegrated. They must be homogeneous, freeze resistant, unaffected by water or air and shouldn't contain neither earthly nor organic components, nor soluble components. They must be of a minimum specific weight of 2,6 t/m^3.

3-1-C-4 CRITERIAS FOR THE CHOICE OF LIMESTONE QUARRIES

3-1-C-4-1 Studies and Testing Before Choosing the Limestone Quarries

The Contractor must carry out the following works.

3-1-C-4-1-1 Geological study on the limestone quarries

The Contractor must present a geological report giving the following estimations:

a. The geological formation of the quarry including covering and homogeneity.

b. The apparent quality of the rock.

c. The rate of fractures and their maximum width.

d. The method of preparation of the quarry (removal of altered materials).

e. The method of extraction and exploitation to obtain the best possible blocometric breakage (blasting plans, drilling equipment, explosives, loading and transportation).

3-1-C-4-1-2 Laboratory Test

The Contractor must take 6 rocky samples coming from the materials extracted from the quarry to be the object of laboratory tests. These tests must lead to the following results:

- Micro-Deval attrition test(> 20)- AFNOR P18-572
- Los Angeles Abrasion Test (< 30)- ASTM C131
- Porosity (< 10%)
- Unconfined compression strength (350 kg/cm^2)
- Chemical nature of the material
- Volume weight (>2.6 T/m^3)

These tests much show that the material components are at least 50% from limestone origin.

3-1-C-4-2 Choosing the Limestone Quarries

In the light of the geological report and the laboratory results, the Engineer shall give his approval for the use of the Quarry proposed by the Contractor. His approval does not affect the responsibility of the Contractor.

3-1-D FILL AND BACKFILL

3-1-D-1 FILL AND BACKFILL IN GENERAL

3-1-D-1-1 Description

This work shall consist of all fill and backfill for structures, chutes, canals, pipelines, culverts, headwalls, basins, manholes, inlets, retaining walls, roadways and other specified works.

3-1-D-1-2 General Requirements

Backfilling whether in foundations or in pipe trenches shall be thoroughly compacted by ramming and any subsidence due to consolidation shall be made up with extra compacted material.

Should subsidence occur after any surface reinstatement has been completed the surface reinstatement shall first be removed, the hollows made up and then the surface reinstatement relaid.

Any subsidence that occurs adjacent to the Site of the works which is attributable to the Contractor's activities shall be reinstated to the full satisfaction of the Engineer.

All surfaces whether public or private which are affected by the works shall be reinstated temporarily in the first instance and when the ground has consolidated fully the Contractor shall reinstate the surfaces permanently.

Temporary reinstatement and permanent reinstatement of all surfaces affected by the operations of the Contractor shall be carried out and maintained to the satisfaction of the Engineer and the responsible authority or owner.

Temporary reinstatement shall be carried out immediately after the trenches are backfilled.

Permanent reinstatement shall not be carried out until the ground has consolidated completely. The Contractor shall inform the Engineer before carrying out this work. In the event of further settlement occurring after the completion of the permanent reinstatement, the Contractor shall make the reinstatement good to the approval of the Engineer or responsible authority.

Unless otherwise specified in the drawings or by the Engineer, for the purposes of temporary and permanent reinstatement in bitumen and surfaced roads the surface width of trenches shall be increased by 150 mm on each side of the trench for a depth of 75 mm to provide a solid abutment for the surfacing material. Reinstatement of surfaced roads shall be carried out to the approval of the relevant authority.

The responsible authority shall have the right to carry out permanent reinstatement at the Contractor's expense.

Excavation in open ground shall be reinstated to the condition in which the ground before excavation was commenced. The final surface of the trench shall be flush with the surrounding ground.

In verges and other grass surfaces and after the backfilling has been thoroughly consolidated, the topsoil shall be relaid rolled and planted with grass or other vegetation as directed by the Engineer as may be necessary, and watered until the grass has become well established. Should the planting fail it shall be replanted as required until a satisfactory growth is obtained.

If at any time any reinstatement deteriorates, the Contractor shall restore it to a proper condition immediately.

Should the Contractor not remedy the defect to the Engineer's satisfaction, any remedial work considered necessary may be undertaken by the Employer and/or the responsible authority at the Contractor's expense.

All trees, shrubs and plants shall be carefully transplanted and shall be returned to their original location after the refilling of the excavations. Return of old or mature trees may be waived in cases where the age of the tree makes return impracticable.

Top soil shall be carefully set aside and replaced at the surface of the backfilling.

The trenches shall be refilled and rammed solid as specified in the Contract and shall not be topped up above the original surface level to allow for settlement.

If any trench becomes dangerous the Engineer may call upon the Contractor for its reinstatement at three hours' notice and failing this to have the work done by others at the Contractor's expense.

3-1-D-2 COMPACTION OF EARTHWORK

3-1-D-2-1 Description

This work shall consist of the compaction of earthwork by rolling or tamping or any combination of these methods in accordance with the requirements for the Moisture Range and Type designated or ordered by the Engineer.

3-1-D-2-2 General Requirements

Each layer shall be compacted to a density between 90 and 95 % of the maximum density. This maximum density shall be determined by the AASHTO T 180-93, method D test or equivalent Standard Test for cohesive soils, by the ASTM D 2049 test or equivalent Standard Test for cohesionless soils.

In case where borderline materials are encountered, both the above mentioned tests will be utilized and the test which results in the higher laboratory maximum density shall be used as a standard to which the field density is compared.

Each layer of earth fill shall be compacted by approved tamping or sheepsfoot rollers, pneumatic tired rollers, or other mechanical means as requested by the Engineer and depending on the soil nature.

At locations where it would be impractical because of inaccessibility to use such compacting equipment, fill layers shall be compacted to the specified requirements by hand directed compaction equipment.

Whenever fill is placed adjacent to structures or at locations where it is not practicable to use a roller, the fill material shall be well tamped by the use of mechanical rammers or tampers. Each layer shall be compacted to a density equal to or greater than obtained under the above rolling procedure for the type of compaction designated. Each layer must be approved by the Engineer before the next layer is placed. When the quantity of work is small, a hand tamper may be used with the permission of the Engineer.

At the time of compaction, the moisture content of the soil shall be within the moisture range as defined in the Test Methods. When the moisture content of the soil does not fall within the required moisture range, water shall be added and thoroughly mixed with the soil, by approved methods or the material shall be aerated, whichever is needed to adjust the soil to the specified moisture content before compaction.

3-1-D-3 BACKFILL FOR STRUCTURES

3-1-D-3-1 *Description*

This work shall consist of backfilling with suitable excavated or borrowed material (Selected Fill and Backfill), uniformly distributed and thoroughly compacted, around structures, chutes, culverts, manholes, retaining walls, or other structures.

3-1-D-3-2 *General Requirements*

Structure backfill shall not be placed until the structure has been inspected by the Engineer and approved for backfilling. In general, no structure shall be subjected to the pressures of backfilling or to live loads until three (3) days after the expiration of the period designated for the removal of forms. At the direction of the Engineer, this period may be extended if subnormal curing conditions exist. Backfill, placed around culverts, abutments and piers, or a particular structure as designed by the Engineer, shall be deposited on both sides to approximately reach the same elevation at the same time. Special care shall be taken to prevent any wedging action against the structure. The slopes bounding the excavation shall be stepped, when necessary, to prevent such wedge action. Whenever backfill is placed in back of or over arches, culverts or rigid frames, the fill shall be first placed midway between the ends of the structure, working equally both ways from the center of the structure toward the ends.

The material shall be placed in layers and compacted by means of suitable equipment, or by ramping with mechanical tampers or hand tampers. Each layer shall be compacted to a density equal to or greater than ninety-five (95) percent of the maximum density determined by AASHTO T 180-74, Method D. Each successive layer shall contain only that amount of material which will ensure proper compaction, but in no case shall any layer be greater than twenty (20) centimeters (compacted measurement) in thickness. When backfilling and compacting around retaining walls, extreme care shall be exercised to prevent forward movement of the wall. If not specified elsewhere or indicated on the plans, the backfill around structures shall be completed to the level of the original ground or to the finished ground level, whichever is lower unless otherwise specified.

3-1-D-4 BACKFILLING PIPE TRENCHES

3-1-D-4-1 *Preparation of the excavation bottom*

The excavation bottom shall be shaped according to the pipe's slope, and must not be loosened. However, if it is loosened, the initial bearing capacity shall be restored by compacting or by any other means.

3-1-D-4-2 *Laying bed*

Generally, the laying bed shall be executed with selected materials (as described below) except for a sandy soil where it is possible, upon the Engineer's approval, to use the excavation bottom that has been leveled and made compact as a laying bed. The theoretical thicknesses of the bed under the pipe works shall be at least equal to 10 cm. Nooks shall be performed in order to facilitate couplings connections. The laying bed shall enable the loads to be uniformly distributed on the support surface. It shall be necessary to lay pipes in such a way that the pressure is not concentrated in one area.

If the laying bed is located in a drain zone or in a pumping zone, it is necessary to prevent the materials of the laying bed from being carried away towards neighboring soils or inside the drainage equipment.

The preparation of the laying bed should not damage an eventual external protection of the pipe works.

The laying bed thickness under the pipe shall be at least equal to 10 cm + 1/10 of nominal diameter in cm, for the pipe works.

3-1-D-4-3 *Sand fill protecting layer (initial backfill)*

Use only selected fill, sand or other approved material complying with following:

Standard Sieve No. #	% Passing
¾	100
# 4	25-100
# 16	10-75
# 40	5-30
# 100	3-10
# 200	0-5

Initial backfill shall be used as bedding material underneath the pipe, and for filling around the pipe and above the top of the pipe (to the dimensions indicated on Drawings) compacted to 95 % of proctor maximum dry density by a compacting machine suitable for trench width. Material around the pipes shall be compacted with proper tools as recommended by the manufacture, and as directed by the Engineer.

In general, the initial backfill should be sand fill. However where required by the Engineer, the initial backfill could be granular material (or granular with high sand content) according to the recommendations of the concerned pipe supplier.

3-1-D-4-4 *Concrete Encasement*

In some particular cases (narrow trench not allowing a normal compacting, repartition of loads to be improved, pipes located near foundations, etc.), pipes may be encased partially or totally with concrete. The casing operation shall be performed according to the details indicated on the drawings and to the indications of the Engineer.

The concrete coating shall consist of plain or reinforced concrete, depending on the cases and according to the instructions given by the administration.

The minimal thickness of the encasement shall be equal to 1/4 the nominal diameter with a minimum of 10 cm.

3-1-D-4-5 Main Backfill

Material excavated from the trenches are suitable for compaction and can be used as main backfill over sand protecting layer around the pipes, otherwise use material with a maximum size of 50 mms, well graded and suitable for compaction and approved by the Engineer.

- Backfill shall be laid and well compacted in layers not exceeding 200 mm thick, compacted to 95 % of proctor maximum dry density by a compacting machine suitable for trench width.
- Do not use heavy compactors over pipe trench until there is 600 mm (or as required by the pipe supplier) cover over the pipe.
- If the cover over the top of the pipe is less than 600 mm (or as required by the pipe supplier), use concrete encasement as specified on the drawings and directed by the Engineer.
- When backfilling to pipes with concrete beds and surrounds, do not start backfilling before 24 hours or allow heavy compactors and traffic over the pipes before 72 hours of placing concrete.
- Use temporary crossing over the trench to prevent damaging the pipes.

3-1-D-5 SPECIAL BACKFILLS

3-1-D-5-1 Execution Of Rocks Paving

The rocks in accordance with the required specifications for this particular zone shall be placed to the maximum possible position in its final locations. The finishing of the rock paving demands individual arrangement of each block by means of a heavy mechanical equipment for the big blocks and by hand equipment for the smaller blocks, in a manner that a linear and plain surface is obtained free of any knobs.

If necessary, in some locations that the contractor should proceed with filling the voids between the big blocks by hand width a smaller size in order to obtain a consistent and compact volume.

The contractor must take all necessary measures to ensure safety and security of the site while paving with big chunks of rocks.

3-1-D-5-1-1 Rockfill

These backfills are discharged and leveled by bulldozer in slightly horizontal layers of 100cm after compaction. The biggest blocks, not bigger than 70 cm, are evenly distributed in the mass.

The equipment used and the number of operations must provide a good compaction with results being at least equal to those obtained with an 8 tons per linear meter of width vibrating roll, of a vibration frequency of 1500 to 1800 cycles per minutes with 6 operations at a 1.8 km/h speed.

The faces should present a certain aspect of unity, For that, the Contractor proceeds to a classification of block facings of same size. The blocks are sorted out at the quarry and prepared for the fill layer.

3-1-D-5-1-2Filters and Drains

These backfills are unloaded avoiding any segregation and are leveled by a bulldozer in slightly horizontal layers of 15 cm after compaction. The equipment used and the number of operations must provide a good compaction with results being at least equal to those obtained with 8 tons vibrating roll per linear meter of width, of a vibration frequency of 1500 to 1800 cycles per minute at a 1.8 km/h speed (6 to 7 passes). Alternatives leading to the same degree of compaction could be proposed by the Contractor and submitted to the Engineer for approval.

3-1-D-6 RIPRAP

3-1-D-6-1 DESCRIPTION

This work shall consist of furnishing and placing one (1) or more layers of riprap on a prepared surface in conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the Engineer.

3-1-D-6-2 MATERIALS

Riprap shall consist of aggregate, from hard, durable, quarried or natural stone having an apparent specific gravity of not less than 2.4, and the absorption shall not exceed 5 percent.

The stone shall be free of weak laminations and cleavages, and shall not disintegrate on exposure to water or weathering. The aggregate shall be round or angular.

3-1-D-6-3 GRADATION REQUIREMENTS

Small size riprap gradation shall be as follows:

SIEVE OPENING SIZE IN CENTIMETERS	PERCENT PASSING (By weight)
20	100
15	50
10	0

Medium size riprap gradation shall be as follows:

SIEVE OPENING SIZE IN CENTIMETERS	PERCENT PASSING (By weight)
40	100
30	50
20	0

3-1-D-6-4 CONSTRUCTION REQUIREMENTS

3-1-D-6-4-1Subgrade Preparation

The Contractor shall, as a part of this work and prior to the delivery of the material for the riprap, prepare the bed surface by sprinkling, blading, rolling, and lightly scarifying where necessary, until the proper slope is obtained for pipe riprap placing. However, in the process of shaping the bed, the originally compacted crust or top portion of the bed shall be disturbed as little as possible. When completed and ready for riprap construction, the bed shall be well compacted, smooth, hard and uniform, all irregularities having been bladed out and rolled down.

3-1-D-6-4-2Placing

The material shall be so handled as to avoid segregation. If an aggregate spreader causes segregation in the material or leaves ridges or other objectionable marks on the surface which cannot be eliminated easily or prevented by adjustment of the spreader operation, the use of such spreader shall be discontinued and replaced. All segregated material shall be removed and replaced with well-graded material. No "skin" patching shall be permitted.

Riprap shall be placed to grade in a manner to ensure that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger rock fragments in such a manner as will result in well-keyed, densely placed, uniform layers of riprap of the specified thickness. Hand placing will be required only to the extent necessary to secure the results specified above.

All bumps and depressions and thickness deficiencies exceeding the specified tolerance of five (5) centimeters shall be corrected by removing the defective work or by adding new material as directed by the Engineer.

3-1-D-6-5 SMALL SIZE RIPRAP WITH BITUMINOUS MASTIC

3-1-D-6-5-1Description

This work shall consist of furnishing and placing one (1) or more layers of riprap, on a prepared surface, and to fill the joints between the stones with sand-asphalt mastic in conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the Engineer.

3-1-D-6-5-2 Materials

3-1-D-6-5-2-1 Gradation Requirements

Riprap shall consist of aggregate, from hard, durable, quarried or natural stone having an apparent specific gravity of not less than 2.4, and the absorption shall not exceed 5 percent. The stone shall be free of weak laminations and cleavages, and shall not disintegrate on exposure to water or weathering. The aggregate shall be round or angular.

Small size riprap gradation shall be as follows.

SIEVE OPENING SIZE IN CENTIMETERS	PERCENT PASSING (By weight)
20	100
15	50
10	0

Sand-asphalt shall consist of a hot-laid mixture of asphalt and mineral aggregates conforming to the requirements below:

AASHTO SIEVE	PERCENT PASSING
1/2 inch	100
3/8 inch	80 to 100
No. 4	55 to 75
No. 10	32 to 47
No. 40	16 to 26
No. 80	10 to 18
No. 200	4 to 10
Asphaltic binder	16 % by weight of the aggregates

3-1-D-6-5-2-2 Physical Requirements for Sand-Asphalt

Mineral Aggregates

Mineral aggregates for "sand-asphalt" shall consist of fine aggregates, and filler material if required. When the grading of the available aggregates is deficient in material passing the AASHTO No. 200 sieve, mineral filler shall be added as approved by the Engineer. Mineral filler shall consist of finely divided mineral matter such as rock dust, including limestone dust, slag dust, hydrated lime, hydraulic cement, or other suitable mineral matter.

The combined mineral aggregate shall meet the following physical requirements:

↑ Loss of Sodium Sulfate Soundness Test (AASHTO T 104)	10 percent maximum
↑ Loss of Magnesium Sulfate Soundness Test (AASHTO T 104)	12 percent maximum
↑ Loss by Abrasion Test (AASHTO T 96)	40 percent maximum
↑ Thin and elongated pieces, by weight (larger than 1 inch, thickness less than 1/5 length)	5 percent
↑ Friable Particles (AASHTO T 112)	0.25 percent maximum
↑ Sand Equivalent (AASHTO T 176) determined after all processing except for addition of asphalt binder	45 minimum
↑ Plasticity index (AASHTO T 90)	3 maximum

Asphalts

Asphalts for "sand-asphalt" shall be petroleum asphalt cement, grade 60-70 penetration, conforming to the following requirements:

Designation	Test Method	Requirement
Penetration, 25 degrees C, 100 grams, 5 seconds	AASHTO T 49	60-70
Viscosity at 135 degrees C	ASTM E 102	100
Flash point (Cleveland) open cup, degrees C	AASHTO T 48	232.2
Ductility at 25 degrees C	AASHTO T 51	100
Solubility in organic solvents, percent	AASHTO T 44	99.5

The asphalt shall be prepared by the refining of petroleum. It shall be uniform in character and shall not foam when heated to 176.7 degrees Celsius.

Job-Mix Approval

At least thirty (30) days prior to the date he intends to begin production of plant-mix "sand-asphalt" mixtures, and after receiving approval of the aggregates from the Engineer, and after receiving the approval of the source of asphalt, the contractor shall make written request for the approved job-mix formula from the Engineer.

The job-mix formula shall combine the mineral aggregates and asphalt in such proportion as to produce a mixture conforming to the following composition limits by weight:

	PERCENT
Total Mineral Aggregates	88 - 84
Asphaltic Binder	12 - 16

When tested according to the Marshall method, the bituminous mixture shall conform to the following requirements:

Stability (kilograms)	700 minimum
Flow (millimeters)	2.4 - 4.0
Voids in total mix (percent)	3.0 - 5.0
Voids filled with asphalt (percent)	70 - 80

All trial mixes shall be prepared and tested by the Contractor. Results will be submitted to the Engineer and, if necessary, direct the Contractor to readjust the Plant to maintain conformity to the job-mix formula. If, during production, the grading of the aggregates alters, the mix shall be redesigned and the plant readjusted as outlined above.

The assistance of the Engineer in the preparation of the job-mix formula in no way relieves the Contractor of the responsibility of producing a bituminous mixture meeting the requirements of the specifications.

Preparation of Sand-Asphalt Mixture

Dried aggregate as specified for bituminous construction shall be combined in the plant in the proportionate amounts as approved. Asphalt shall be introduced into the mixture according to the job-mix formula.

The initial mixing time will be designated by the Contractor. Mixing time may be increased by the Engineer if additional time is necessary to obtain a homogeneous mixture and satisfactory coating.

The temperature of the asphalt, except for temporary fluctuations, shall not be lower than fourteen (14) degrees C below the temperature of the aggregate at the time the two (2) materials enter the mixer or plug mill.

3-1-D-6-5-3 Construction Requirements 3-

1-D-6-5-3-1 Subgrade Preparation

The Contractor shall, as a part of the work and prior to the delivery of the material for riprap and sand-asphalt mixture, prepare the bed surface by sprinkling, blading, rolling, and lightly scarifying where necessary, until the proper slope is obtained. However, in the process of shaping the bed, the originally compacted crust or top portion of the bed shall be disturbed as little as possible. When completed and ready for riprap and sand-asphalt construction, the bed shall be well compacted, smooth, hard and uniform, all irregularities having been bladed out and rolled down.

3-1-D-6-5-3-2 Placing

The material shall be so handled as to avoid segregation. If an aggregate spreader causes segregation in the material or leaves ridges or other objectionable marks on the surface which cannot be eliminated easily or prevented by adjustment of the spreader operation, the use of such spreader shall be discontinued and replaced. All segregated material shall be removed and replaced with well-graded material. No "skin" patching shall be permitted.

Riprap shall be placed to grade in a manner to ensure that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger rock fragments in such a manner as will result in well-keyed, densely placed, uniform layers of riprap of the specified thickness. Hand placing will be required only to the extent necessary to secure the results specified above.

All humps and depressions and thickness deficiencies exceeding the specified tolerance of five (5) centimeters shall be corrected by removing the defective work or by adding new material as directed by the Engineer.

After placing the stones for riprap as described above, in surfaces and thicknesses approved by the Engineer, the Contractor shall fill all the joints between the stones with the approved sand-asphalt mastic.

At least thirty (30) days prior to the date to begin placing of plant-mixed "sand-asphalt" mixtures, and after receiving approval of the sand-asphalt job-mix from the Engineer, the Contractor shall make written request for the approved method of transport and placement of the sand-asphalt from the Engineer. No mixture shall be placed prior to the Engineer's approval of the Contractor's methods and procedures for placing the mixture.

All mixed material shall be delivered to their final location in time to permit the mixture to be placed during daylight hours.

All bituminous mixtures shall be delivered to their final location at a temperature between 139 degrees C - 163 degrees C. Mixtures delivered at lower temperatures shall be discarded.

3-1-D-6-5-3-3 Weather Limitations

Sand-asphalt mixtures shall be placed only when the air temperature is four (4) degrees C or above, and when the weather is not foggy or rainy and when the existing surfaces free are free from moisture.

3-1-E TESTS ON MATERIALS

3-1-E-1 TEST METHODS

3-1-E-1-1 Moisture - Density Curve Test

A Moisture - Density Curve (AASHTO T 180-93, Method D or equivalent standard) will be determined for each type of soil to be used in the construction of the work to determine the Maximum Density, the Optimum Moisture content and the Moisture Range required of the soil for satisfactory compaction. The field density and actual Moisture Content of the compacted embankment shall be determined by field curves according to AASHTO T 191 or equivalent standard.

3-1-E-1-1-1 Maximum Density

The Maximum Dry Density as determined by the Moisture-Density curve shall be the density to which the Field Density is referred for comparison or percentage for each type of soil used in the work.

3-1-E-1-1-2 Optimum Moisture

The Optimum shall be the moisture content corresponding to the Maximum Density on the Moisture - Density curve.

3-1-E-1-1-3 Moisture Range

The Moisture Range shall be the limits of moisture content of each type of soil with the Optimum moisture as a reference.

3-1-E-1-1-4 Field Density

The Field Density shall be the density of the compacted fill determined by the Field Density Test.

3-1-E-1-1-5 Moisture Content

It is the percentage of moisture in the specimen based on oven dry mass of soil. The Moisture Content shall be the actual moisture content of the soil in the compacted embankment at the time of compaction.

3-1-E-1-2 Relative Density Test

For cohesionless free draining soils for which impact compaction will not produce a well-defined Moisture-Density relationship curve, the test for the Relative Density of Cohesionless Soils (ASTM D2049 or equivalent Standard) shall be used to determine the relative density.

Relative density is defined as the state of compactness of a soil with respect to the loosest and densest states at which it can be placed by the laboratory procedures described in ASTM D2049 or equivalent Standard. The Field Density and actual Moisture Content of the compacted embankment shall be determined by field tests according to AASHTO T 191-93 or T 238-86 or equivalent Standards.

3-1-E-1-2-1 Relative Density

The Relative Density as determined by the Relative Density Test shall be the standard to which the Field Density is referred for comparison for each type of cohesionless soil used in the Work.

3-1-E-1-2-2 Field Density

The Field Density shall be the density of the compacted fill determined by the Field Density Test.

3-1-E-1-2-3 Moisture Content

It is the percentage of moisture in the specimen based on oven dry mass of soil. The Moisture Content shall be the actual moisture content of the soil in the compacted fill at the time of compaction.

3-1-E-2 GENERAL PRESCRIPTION

The Contractor shall keep a constant control on the works by mean of tests, under the control of the Engineer. These tests shall be done in a laboratory site fit with equipment and staff personnel in order to accomplish the necessary tests specified below and before without delay. The list of equipment and staff will be submitted to the approval of the Engineer.
The Contractor can eventually subcontract a part of the test to specialized laboratories.
The Contractor has to submit to the approval of the Engineer, the laboratories as well as the list of test to subcontract.
The approval of the Engineer to undertake the tests in these laboratories does not relieve Contractor from his responsibility.
If the Engineer refuses to give his approval to accomplish certain tests outside the working field, the Contractor will have to undertake them in the field laboratory and equip it in consequence.

If during the works, the Engineer is not satisfied by the progress of the tests, as planned by the Contractor, he can ask the Contractor to modify his arrangements.
The necessary tests and samplings should be undertaken according to the recommendations of the French, American and British specifications or others agreed by the Engineer.

The Contractor must take into consideration all the necessary expenses for:

1. The samplings (undertaken by the field staff or by a specialized laboratory).
2. The transportation of the samplings from the field to the laboratory.
3. The conservation and treatment of the samples before the tests.
4. The tests and the result reports.

The number and types of tests listed below and above are provided for the control and good execution of the Contract. The Engineer could require other tests or increase the frequency of the tests and their number, if doubting their conformity with the specifications. The Contractor will have to undertake these supplementary tests on his expenses, without any claim or price revision.

3-1-E-3 TESTS ON BORROWED MATERIALS

All borrow material for the construction will be tested before use. The Contractor must submit to the Engineer as soon as possible and at the latest 15 days after the date of the notification of the contract, a detailed program and the time program of the tests.

3-1-E-3-1 TESTS AND SAMPLING RELATIVE TO THE FILTERS, DRAINS AND ROCKFILL MATERIALS

a. On quarry refer to related paragraph above.

b. During execution:

The necessary tests for the approval of the filters and drains materials are:

- Sieve analysis
- Specific gravity
- Proctor (When necessary)
- Compression tests on original rocky materials.

It is necessary to undertake a series of tests per 240 m^3 of filter, drain and rockfill and when requested by the Engineer.

3-1-E-3-2 TESTS AND SAMPLING RELATIVE TO THE INITIAL BACKFILL, MAIN BACKFILL AND SELECTED FILL AND BACKFILL

a. On quarry refer to related paragraph above.

b. During execution:

The necessary tests for the approval of these materials are:

- Sieve analysis
- Specific gravity
- Proctor.
- Plasticity Index (When necessary)

It is necessary to undertake a series of tests per 100 m^3 of initial backfill, Main backfill and Selected Fill and Backfill and when the request by the Engineer.

3-1-F WIRE ENCLOSED RIPRAP (GABIONS)

3-1-F-1 DESCRIPTION

This work shall consist of the installation of wire-enclosed riprap (gabions) in the locations designated on the plans.

3-1-F-2 MATERIALS

3-1-F-2-1 Aggregate

Aggregate for riprap shall be hard, durable, quarried or natural stone having an apparent specific gravity of not less than 2.4, and the absorption shall not exceed 5 percent. The stone shall be free of weak laminations and cleavages, and shall not disintegrate on exposure to water or weathering. The aggregate shall be round or angular and not less than 95 percent of the stone shall be retained on a screen having 3 inch square openings.

3-1-F-2-2 Wire-enclosed Riprap (Gabions)

Gabions shall be constructed of wire mesh. The wire mesh shall be made of galvanized steel wire having a minimum size of 0.120-inch diameter (U.S. Wire Gage No.11). The tensile strength of the wire shall be in the range of 60,000 to 85,000 psi, determined in accordance with ASTM A392. The minimum zinc coating of the wire shall be 0.80 oz./sq.ft. of uncoated wire surface as determined in accordance with ASTM A90.

Selvedge, tie, and connection wire shall meet the same strength and coating requirements specified above for wire used in the wire mesh.

3-1-F-2-3 Fabrication

The wire mesh shall be twisted to form hexagonal openings of uniform size. The maximum linear dimension of the mesh opening shall not exceed 4-1/2 inches and the area of the mesh opening shall not exceed 8 square inches. The mesh shall be fabricated in such a manner as to be non-raveling. Non-raveling is defined as the ability to resist pulling apart at any of the twists or connections forming the mesh when a single wire strand in a section is cut.

Gabions shall be fabricated so the sides, ends, lid, and diaphragms can be assembled at the construction site into rectangular baskets of the specified size. Gabions shall be of single unit construction-base, lid, ends, and sides shall be, either woven into a single unit or one edge of these members connected to the base section of the gabion in a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.

Where the length of the gabion exceeds its horizontal width, the gabion shall be equally divided by diaphragms of the same mesh and gauge as the body of the gabions, into cells the length of which does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in a manner that no additional tying at this junction will be necessary.

All perimeter edges of the mesh forming the gabion shall be securely clip bound or selvedges so that the joints formed by tying the selvedges have at least the same strength as the body of the mesh.

Selvedge wire used through all the edges (perimeter wire) shall not be less than 0. 148-inch diameter (US. Wire Gage No. 9) and shall meet the same strength and coating specifications as the wire mesh.

Tie and connection wire shall be supplied in sufficient quantity to securely fasten all edges of the gabion and diaphragms and to provide for at least four cross connecting wires in each cell whose height is equal to the width and at least two cross connecting wires in each cell whose height is one-half the width of the gabion. Cross connecting wires will not be required when the height of the cell is one-third the width of the gabion. Tie and connection wire shall meet the same strength and coating specifications as the wire used in the mesh, except that it may be as much as two gages smaller.

In lieu of tie wire, two-gauge galvanized hog rings may be used to connect adjacent baskets and to secure basket lids. Spacing of the hog rings shall not exceed 6 inches.
Vertical joints in the completed work shall be staggered at approximately 1/3 or 1/2 the length of the full baskets.

3-1-F-2-4 *Installation*

The gabions shall be placed on a smooth foundation. Final line and grade shall be approved by the Engineer.
Each gabion unit shall be assembled by binding together all vertical edges with wire ties on approximately 6 inch spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil about every 4 inches. Empty gabion units shall be set to line and grade as shown on the plans or as directed by the Engineer. Wire ties, hog rings, or connecting wire shall be used to join the units together in the same manner as described above for assembling. Internal tie wires shall be uniformly spaced and securely fastened in each cell of the structure.
A standard fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and hold alignment.
The gabions shall be filled with stone carefully placed by hand or machine to assure alignment and avoid bulges with a minimum of voids. Alternate placing of rock and connection wires shall be performed until the gabion is filled. After a gabion has been filled, the lid shall be bent over until it meets the sides and edges. The lid shall then be secured to the sides, ends and diaphragms with the wire ties or connecting wire in the manner described above for assembling.

Part III-2: CONCRETE

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PART 3.2 - CIVIL WORKS:CONCRETE

3-2-A CONCRETE

3-2-A-1 DESCRIPTION

Concrete shall consist of a mixture of cement, water and aggregates without air-entraining or water-reducing admixture unless specified otherwise.

Precautions are required to minimize the risk of alkali aggregate reaction. The Contractor shall demonstrate the adequacy of his proposals when he supplies details of his mix design. Unless otherwise agreed, when calculating the cementitious alkali contribution, the maximum cement content in the schedule shall be used.

When calculating the alkali contribution of cement replacements Method, A of Clause 3.8 of BS 5328 Part 4 shall be used.

3-2-A-2 CONCRETE MATERIALS

3-2-A-2-1 Cement

The types of cement to be used are in general: cement type P for ordinary concrete, cement type PA-S 32.5 for hydraulic concrete and sulfate resisting cement type P-RMS or P-RSS for concrete exposed to sulfate attack. The cement classes should be as defined by the Lebanese norms LIBNOR. However, the Engineer has the right to impose the use of any type of cement in any type of concrete and in any structure according to the concrete exposure and other conditions.

3-2-A-2-1-1 Mixing of Cements

Only one (1) type or brand of cement shall be used in any one structural member. Mixing of types or brands will not be permitted.

3-2-A-2-1-2 Tests and Acceptance

Cement shall be tested for conformance with Lebanese Norms or AASHTO M 85 or British Standard 12 and shall have a compressive strength of standard cement mortar samples at twenty-eight (28) days of not less than two hundred fifty (250) kilograms per square centimeter. All cement is subject to the Engineer's approval and shipments of cement shall be accompanied by a manufacturer's Certificate of Guarantee and/or laboratory test certificate. The Engineer reserves the right to order a retest of the cement at any time. Approval of a cement quality shall not relieve the Contractor of the responsibility to fabricate concrete of the specified strength. The Contractor shall bear all costs in connection with the Certificates of Guarantee and laboratory tests. When tests of factory or field tests subsequent to the original approval tests show that the cement does not comply with the specifications, the entire consignment from which the sample was taken will be rejected and the Contractor shall immediately remove the rejected material from the site and replace it with cement, which meets the required specifications.

3-2-A-2-1-3 Storage

Storage capacity shall be sufficient to meet the requirements for 30 (thirty) working days unless in the opinion of the Engineer the supply from the manufacturer is so limited that more storage capacity is necessary. Cement shall be stored in moisture-proof storage sheds in such a manner that the oldest is used first. Neither stale, caked nor reclaimed or re-sacked cement shall be used. The Contractor shall not store cement in areas subject to flooding.

Cement remaining in bulk storage at the mill prior to shipment for more than six (6) months or cement stored in bags in local storage by the Contractor or a vendor for more than three (3) months after shipment from the mill, may be retested before use and will be rejected if it fails to meet any of the requirements of these specifications.

3-2-A-2-2 Aggregates

3-2-A-2-2-1 Fine Aggregates

Fine aggregates shall conform to AASHTO M6 and shall consist of natural sand of sand equivalent of more than 80%, or, if approved by the engineer, crushed rock having hard and durable particles having similar characteristics: 100% passing 5 mm sieve, 65% to 85 % passing 1.25mm and 5% to 10% passing 0.15 mm sieve. The percentage of particles passing the 0.08mm. sieve should be less than: 3% for natural sand and 5% for crushed sand. The fine aggregates shall not contain harmful materials such as iron pyrites, coal, mica, shale or similar laminated materials such as flat and elongated particles or any materials which may attack the reinforcement in such a form or in sufficient quantity as to adversely affect the strength, durability and texture of the concrete.

3-2-A-2-2-2 Coarse Aggregates

Coarse aggregates shall conform to AASHTO M80 and shall consist of gravel, crushed gravel, or crushed stone free from coating of clay or other deleterious substances. It shall not contain harmful or any other materials in such a form or in sufficient quantity as to adversely affect the strength and durability of the concrete. If necessary, coarse aggregate shall be washed to remove deleterious substances or for consistency of concrete color.

3-2-A-2-2-3 Combined Aggregates

Combined aggregates are composed of a mixture of coarse aggregates and fine aggregates. They shall be used only in proportions with the prior approval of the engineer. In no case shall materials passing No. 200 (0.075 mm) sieve exceed 3% by weight of the combined aggregates.

3-2-A-2-3 Water

All sources of water to be used with cement whether for mixing or curing of concrete, or compaction of backfill around the concrete structures, shall be approved by the Engineer. If at any time during construction, water from an approved source becomes unsatisfactory, the Contractor shall provide satisfactory water from other main sources.

Water shall be free from injurious quantities of oil, alkali, vegetable matter and salt as determined by the Engineer. The water shall be reasonably clear and shall contain not more than one quarter (0.25) percent solids by weight. Water shall comply with the requirements of AASHTO T26 and BS 3148. If the specific conductance is less than 1500 micro ohms per centimeter the total solids contents requirement may be waived.

3-2-A-2-4 Admixture

Where directed by the Engineer, all the necessary additives shall be used (Air Entrained Agent, plasticizers, protection of concrete in contact with water from the evaporation of lime, waterproofing, etc.). In particular a retarding admixture set shall be used. The admixture proposed for use shall be approved by the Engineer before it is incorporated into the Work. The admixture shall be Type D as specified in AASHTO M 194.

3-2-A-3 ASSEMBLY AND HANDLING OF MATERIALS

3-2-A-3-1 Assembly of Aggregates

Aggregates shall be assembled in such quantities that sufficient material approved by the Engineer is available to complete any continuous pour necessary for structures. The batching site shall be of adequate size to permit the stockpiling of sufficient, non-segregated materials, having proper and uniform moisture content to ensure continuous and uniform operation. Aggregates shall enter the mixer in a manner approved by the Engineer and in such a manner to ensure that no matter foreign to the concrete or matter capable of changing the desired proportions is included. In the event two (2) or more sizes or types of coarse or fine aggregates are used on the same project, only one (1) size or type of each aggregate may be used on one (1) continuous concrete pour.

3-2-A-3-2 Stockpiling of Aggregates

All aggregates shall be stockpiled before use in order to prevent segregation of material, to ensure a uniform moisture content, to provide uniform conditions for proportioning plant control and to aid in obtaining concrete that is uniform as to materials and moisture content.

The use of equipment or methods of handling aggregates which results in the degradation of the aggregates is strictly prohibited. Bulldozers with metal tracks shall not be used on coarse aggregate stockpiles. All equipment used for handling aggregates shall be approved by the Engineer.

Stockpiling of aggregates shall be in the manner approved by the Engineer and in addition, every precaution shall be taken to prevent segregation. Segregation shall be prevented by making no layer higher than one and one-half (1.5) meters and if two (2) or more layers are required, each successive layer shall not be allowed to "cone" down over the next lower layer.

Aggregates shall not be stockpiled against the supports of proportioning hoppers and weighing devices.

Aggregates shall be stockpiled and protected at locations which preclude contamination by brackish groundwater during periods of high water or contamination from other sources which might detrimentally affect the aggregates. Contaminated aggregates shall not be used in the concrete.

When required, the aggregate stockpiles shall be sprinkled with water, twelve (12) hours prior to use, to maintain a moisture content in the aggregate equivalent to the water absorption value of the aggregate as determined by AASHTO T 84 and AASHTO T 85.

3-2-A-3-3 Segregation

Segregated aggregates shall not be used until they have been thoroughly remixed and the resultant pile is of uniform and acceptable gradation at any point from which a representative sample is taken. The Contractor shall remix aggregate piles when ordered by the Engineer.

3-2-A-3-4 Transporting of Aggregates

If aggregates are to be transported from a central proportioning plant to the mixer in hatch-boxes or dump trucks, such equipment shall be of sufficient capacity to carry the full volume of materials for each batch of concrete. Partitions separating batches shall be approved by the Engineer and shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped.

3-2-A-3-5 Cement Storing And Stockpiling

Cement in storage or stockpiled on the site shall be protected from any damage by climatic conditions. Methods of storing or stockpiling shall be approved by the Engineer. Cement shall be transported to the mixer in the original sacks. Each batch shall contain the full amount of cement for the batch. Batches where cement is placed in contact with the aggregates may be rejected unless mixed within one and one-half (1-1/2) hours.

3-2-A-4 COMPOSITION OF CONCRETE

3-2-A-4-1 Requirements

The mix proportions shall be selected to ensure that the workability of the fresh concrete is suitable for the conditions of handling and placing, having regard to the structural element being constructed.
In the event of sulphate exposure precautions requiring lower cement content than those required for normal conditions the latter requirements shall prevail.

The maximum cement content in any mix shall not exceed 500 kg/m3 for normal structures and 450 kg/m3 for liquid retaining structures.

In all cases of mix proportioning, the added water shall be included with due allowance for the moisture contained in the aggregates and shall be the minimum consistent with the workability requirements.

3-2-A-4-1-1 Strength

The characteristic strength of concrete means that value of the 28 day below which 5% of all possible test results would be expected to fall.

3-2-A-4-2 Mix Proportions & Measurement for Proportioning Materials

The Contractor shall be responsible for the design of the concrete and shall consult with the Engineer as to mix proportions at least forty-five (45) days prior to beginning concrete work. The actual mix proportions of cement, aggregates and water shall be determined in accordance with BS5328 Parts 2, 3 and 4, by the Contractor under the supervision of the Engineer.

The Contractor shall, in the presence of the Engineer, prepare trial mixes for each class of concrete required for the project, made with the approved materials to be used in the work. The proportions of the trial-mixes shall be such as to produce a dense mixture containing the cement content specified and meeting the plasticity requirements and one hundred fifteen (115) percent of the strength requirements specified for the designated classes of concrete. If the materials supplied by the Contractor are of such a nature or are so graded that proportions based on minimum cement content cannot be used without exceeding the maximum allowable water content, the proportions will be adjusted so as to require the least amount of cement which will produce concrete of the required plasticity and workability without exceeding such allowable water content. No additional payment will be made for increased quantity of cement. Test cylinders shall be made from the trial-mixes.

The Engineer will review the Contractor's trial-mixes and break the test cylinders at seven (7) and twenty-eight (28) days. The Engineer will then determine which of the trial-mixes shall be used. If none of the trial-mixes for a class of concrete meets the specifications, the Engineer will direct the Contractor to prepare additional trial-mixes. No class of concrete shall be prepared or placed until its job-mix proportions have been approved by the Engineer.

The approval of the job-mix proportions by the Engineer or his assistance to the Contractor in establishing those proportions, in no way relieves the Contractor of the responsibility of producing concrete which meets the requirements specified in these specifications.

All costs connected with the preparation of trial-mixes and the design of the job-mixes shall be done by the Contractor, including all laboratory tests and the breaking of the test cylinders.

The limiting values which shall govern for each class of concrete are as follows:

- The cement content specified herein shall be determined from a yield test in accordance with AASHTO T 121.
- Concrete for Structures: Cement, water and aggregate sizes requirements for the various classes of structural concrete are specified in the following table:

Schedule for the specification requirements of designed mixes					
The mixes below shall be supplied as designed mixes in accordance with the relevant clauses of BS 5328: Parts 2, 3 and 4.					
1. Mix reference (Class of concrete)	A	B	C	D	E
2. Minimum Compressive Strength at 28 days (Kg/cm^2)	300	250	200	200	400
3. Nominal maximum size of aggregate, mm	20	20	40 or larger by approval	20	10
4. Types of aggregate:Coarse AASHTO FineAASHTO	M80 M6	M80 M6	M80 M6	M80 M6	M80 M6
5. Minimum cement content, kg/m^3	350	300	200	200	400
6. Maximum free water/cement ratio	0.55	0.55	0.60	0.60	0.55
7. Maximum cement content, kg/m3	375	350	250	250	450
Other Requirements					AEA

Note: AEA – Air Entrainment Agent

The minimum compression strength is the strength measured on test cylinders. The seven (7) day compressive strengths shall not be less than seventy-five (75) percent of the required twenty-eight (28) day strength.

The ultimate compressive strength of the concrete shall be determined on test specimens obtained and prepared in accordance with AASHTO T 23 and AASHTO T 126, except that only six (6) inches [one hundred fifty-two (152) millimeters] by twelve (12) inches [305 millimeters] cylinders shall be used for compression tests. The Contractor shall furnish single use cylinder molds conforming to AASHTO M 205, or when approved by the Engineer, reusable vertical molds made from heavy gauge metal.

3-2-A-4-2-1 Changes in Proportion

As the work progresses, the Engineer reserves the right to require the Contractor to change the proportions from time to time if conditions warrant such changes to produce satisfactory results. Any such changes may be made within the limits of the specifications at no additional compensation to the Contractor.

3-2-A-4-2-2 Measurement for Proportioning Materials

3-2-A-4-2-2-1 Cement

Cement shall be measured by weight. The measurement shall be accurate to within two (2) percent throughout the range of use.

3-2-A-4-2-2-2 Water

The mixing water shall be measured by weight. The measurement shall be accurate to within one (1) percent throughout the range of use.

3-2-A-4-2-2-3 Aggregates

The aggregates shall be measured by weight. The measurement shall be accurate to within one- half (1/2) percent throughout the range of use.

3-2-A-4-3 Concrete

3-2-A-4-3-1 Porous Concrete

Porous concrete shall be composed of ordinary Portland cement and 37.5mm single size aggregate complying with B.S 882. 1201: Part 2.

The ratio of aggregate to cement shall be 8:1 by volume or 10:1 by mass.

The concrete shall be mixed by machine or by hand to a uniform color and consistency before placing. The quantity of water used shall not exceed that required to coat all of the aggregate particles without forming excess grout.

The concrete shall be compacted by hand when total thickness does not exceed 40cm, otherwise it shall be compacted by rollers. The placement for roller compaction shall be in layers but shall not exceed 40cm in thickness per layer.

Permeability shall range between 1×10^{-2} and 1×10^{-3} meter/sec.

Compressive strength: 105 Kg/cm^2.

Contractor shall demonstrate the permeability of porous concrete in place by an effective field testing method that is approved by the Engineer. Contractor shall also install a laboratory on site for testing the permeability of concrete on samples before any placing of porous concrete. The permeability test method shall be approved by the Engineer.

3-2-A-4-3-2 Cyclopean Concrete

Cyclopean concrete shall consist of Class "C" concrete containing large embedded stones. The embedded rubble stones shall be of approved quality, sound and durable, and free from segregations, seams, cracks and other structural defects or imperfections tending to destroy its resistance to the weather. It shall be free from rounded, worn, or weathered surfaces. All weathered stone shall be rejected. The stone shall be kept free from dirt, oil, or any other injurious material which may prevent proper adhesion. The largest dimension of any rubble stone shall not exceed 20 centimeters. The distance between two adjacent rubble stones or between a rubble stone and the form shall not be less than 5 centimeters.

The stone shall be carefully placed-not dropped or cast-so as to avoid injury to the forms or to the partially set adjacent masonry. All stones shall be washed and saturated with water before placing. The total volume of the stone shall not be greater than one third of the total volume of the portion of the work in which it is placed.

3-2-B SPECIAL TYPES OF CONCRETE

3-2-B-1 AIR ENTRAINED CONCRETE

Concrete where specified shall include an approved air-entraining agent capable of producing a 5% air-entrainment with a tolerance of 0.5%.

The mix shall be purposely designed having regard for the nature of grading of the aggregates and air-entraining agent being used.

Preference shall be given to the use of air-entraining agents which can be administered in fixed calibrated amounts through a dependable mechanical dispenser or sachet and which are added to the mixing water.

Frequent air meter tests shall be carried out and the consistency of the air-entrainment maintained to the above tolerances by adjustments in the mix, as may be necessary.

3-2-B-2 CONCRETE IN BENCHING

Concreting for benching in manholes, pumping stations and works structures shall consist of class B concrete (Grade C25) concrete unless otherwise specified. It shall be placed with low workability to the approximate shape required and, while still green, shall be finished with not less than 20 mm of Grade C25 concrete to a steel trowel led finish and to the contours indicated on the Drawings.

3-2-B-3 READY MIX CONCRETE AND CENTRAL MIXED CONCRETE

3-2-B-3-1 Description

"Ready-Mixed Concrete" and "Central-Mixed Concrete" shall consist of a mixture of cement, water and aggregate, without air-entraining or water-reducing admixture. The terms ready-

mixed or central-mixed concrete shall include transit-mixed concrete and all will be referred to hereinafter as ready-mixed concrete.

Ready-mixed concrete may be used in the construction of all work, when approved by the Engineer.

Ready-mixed concrete may be manufactured by previously approved commercial plants or by other approved plants furnished for the work.

Approval of any ready-mixed concrete plant will be granted only when an inspection of the plant indicates that the equipment, the method of storing and handling the materials, the production procedures, the transportations and rate of delivery of concrete from the plant to the point of use, all meet the requirements set forth herein.

Permission to use ready-mixed concrete from any previously approved plant may be rescinded at any time upon failure to comply with the requirements of the specifications.

Ready-mixed concrete shall be mixed and delivered to the point of use by means of one of the following combinations of operations:

Mixed completely in a stationary central-mixing plant and the mixed concrete transported to the point of use in a truck mixer or tank agitator operating at agitator speed, or when approved by the Engineer, in non-agitating equipment (known as "Central-Mixed Concrete").

Mixed completely in a truck mixer at the batching plant or while in transit (known as transit- mixed concrete).

Mixed completely in a truck mixer at the point of use following the addition of mixing water (known as truck-mixed concrete).

A Computerised delivery note to be issued from the batching plant with each transit mixer. Copies of all delivery notes shall be submitted to the Engineer and shall include at least the following information:

1. Name of supplier, serial number of ticket and date.
2. Truck number.
3. Name of Contractor.
4. Name of contract and location of site.
5. Grade of concrete.
6. Specified workability.
7. Type and source of cement.
8. Source of aggregate.
9. Nominal maximum size of aggregate.
10. Time of loading at supplier's works.
11. Quantity of concrete.
12. Arrival and departure times of truck.
13. Time of completion of discharge.
14. Extra water added with the approval of the Engineer.

3-2-B-3-2 Materials

All materials used in the manufacture of ready-mixed concrete shall conform to the requirements of "Concrete section".

3-2-B-3-3 Equipment

3-2-B-3-3-1 General

Equipment shall be of the type and number as outlined in the Contractor's Program of Work, as approved by the Engineer.

3-2-B-3-3-2 Check Tests

The Engineer may, from time to time, make slump tests of individual samples of the concrete at approximately the beginning, the mid-point and end of discharging the load. If the slumps vary by more than the allowable tolerance as specified in the specifications, the mixer or agitator shall not be used unless the condition is corrected to the satisfaction of the Engineer. All mechanical details of the mixer or agitator such as water measuring and discharge apparatus, condition of the blades, speed of rotation of the drum, general mechanical condition of the unit and clearance of the drum shall be checked before further use of the unit will be permitted.

3-2-B-3-3-3 Inspection

Mixers and Agitators shall be examined periodically for changes in condition due to accumulation of hard concrete or mortar or to wear of blades. The mixers shall be cleaned at intervals approved by the Engineer. The pick-up and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down twenty (20) millimeters or more. The Contractor shall:

Have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth, or provide permanent marks on the blades to show points of twenty (20) millimeter wear from new conditions. Drilled holes of six (6) millimeter diameter near each end and at midpoint of each blade are recommended.

Truck mixers and agitators of the revolving-drum type must be equipped with a hatch in the periphery of the drum shell of such design as to permit access to the inside of the drum for inspection, cleaning and repair of the drum and blades.

3-2-B-3-3-4 Composition of concrete

The composition of ready-mixed concrete shall conform to the requirements of "Concrete section".

3-2-C REINFORCING STEEL

3-2-C-1 DESCRIPTION

This Work shall consist of furnishing and placing reinforcing steel in accordance with the specifications and in conformity with the plans.

3-2-C-2 MATERIALS

3-2-C-2-1 Reinforcing Bars

3-2-C-2-1-1 Type

All reinforcing bars shall be of a deformed type in accordance with AASHTO M 31, except that plain bars may be used where specifically indicated on the drawings.

3-2-C-2-1-2 Quality

All steel reinforcement shall be of type FE E40 (min Fy=4,000k/cm2) (deformed), except for ties and stirrups which shall be of type FE E24 (min Fy=2,400k/cm2) (plain). The type of steel to be used shall be as mentioned on drawings.

3-2-C-2-2 Certification and Identification

3-2-C-2-2-1 Certification

Three (3) copies of a mill test report shall be furnished to the Engineer for each lot of billet- steel reinforcement bars proposed for use on the project. The mill test report shall be sworn to for the manufacturer of the steel by a person having legal authority to bind the manufacturer and shall show the following information:

The process or processes used in the manufacture of the steel from which the bars were rolled.

Identification of each heat of open-hearth, basic oxygen or electric furnace and/or each lot of acid Bessemer steel from which the bars are rolled.

Chemical and physical properties of the heat from which the bars were rolled.

3-2-C-2-2-2 Identification

The bars in each lot shall be legibly tagged by the manufacturer and/or fabricator before being offered for inspection. The tag shall show the manufacturer's test number and lot number or other designation that will identify the material with the certificate issued for that lot of steel.

The fabricator shall furnish three (3) copies of a certification which shows the heat number or numbers from which each size of bar in the shipment was fabricated.

3-2-C-2-2-3 Inspection and Sampling

The sampling and testing of reinforcement bars may be made at the source of supply when the quantity to be shipped or other conditions warrant such inspection. Bars not inspected before shipment will be inspected after arrival on the work. Test samples obtained at the destination of the steel shall be duplicate bars not less than one (1) meter in length and bars from which such samples are taken shall be replaced at the Contractor's expense. The Engineer reserves the right to resample and inspect all reinforcement steel upon its arrival at the work site.

All reinforcement bars shall be free from detrimental dirt, mill scale, rust, paint, grease, oil or other foreign substance, fins or tears. The Contractor will not be required to remove slight rusting which discolors the metal. but he shall remove all loose mill scale and scales rust. Brushing to clean blue metal will not be required. There shall be no evidence of piping or visual flaw in the test specimen or on the sheared ends of the bars.

Supports. Metal supports, approved by the Engineer, shall he provided and used to retain the reinforcement at proper distances from the forms. Supports under horizontal bars slabs shall be spaced at not more than eighty (80) diameters of the bar. All reinforcement shall be so rigidly supported and fastened that displacement will not occur during construction. Reinforcing steel shall be inspected in place and must be approved by the Engineer before any concrete is deposited.

3-2-C-2-2-4 Welded Wire Fabric

To be used for the reinforcement of concrete shall conform to the following requirements:

3-2-C-2-2-5 Dimensions

Welded steel wire fabric shall conform to the size and dimensions shown on the plans.

3-2-C-2-2-6 Properties

Wire fabric furnished shall conform to the requirements for "Welded Steel Wire Fabric for Concrete Reinforcement," AASHTO M 55.

3-2-C-3 CONSTRUCTION REQUIREMENTS

3-2-C-3-1 Protection and Storage

Reinforcing steel shall be protected at all times from damage. Reinforcing steel shall be stored above the ground on platforms, skids, or other supports. It shall be stored in such a manner and adequately marked to facilitate inspection and checking. When placed in the Work, the reinforcing steel shall be free from dirt, detrimental scale, paint, oil or other foreign substance.

3-2-C-3-2 Cutting and Bending

All cutting and bending of reinforcement bars shall be done by competent workmen and with equipment approved by the Engineer. Unless shown otherwise on the plans or unless written approval is obtained from the Engineer, all reinforcement bars shall be cut and bent in an on- site fabrication shop.

Bent bar reinforcement shall be cold bent to the shapes shown on the plans, and unless otherwise provided on the plans or by written authorization of the Engineer, bends shall conform to the following requirements:

D = 6d for five (5) millimeter through twenty-two (22) millimeter bar sizes

D = 8d for twenty-four (24) millimeter through twenty-eight (28) millimeter bar sizes D =

10d for thirty (30) millimeter and over bar sizes

Where D = Minimum pin diameter around which a bar may be bent d = Bar diameter

3-2-C-3-3 *Placing, Supporting and Fastening*

All reinforcing steel shall be accurately placed and, during the placing of concrete, firmly held by approved supports in the position shown on the plans. Reinforcing bars shall be securely fastened together. Reinforcement placed in any member shall be inspected and approved before any concrete is placed. Laying or driving bars into the concrete after placement will not be permitted. All horizontal reinforcement shall be supported on metal supports or spacers as approved by the Engineer. The use of small stones or wood blocks for supporting reinforcement will not be permitted. The reinforcement shall be held securely in place at the proper position and spacing as indicated on the plans by the use of wire ties at bar intersections and tying to the supports and spacers. The adequacy of the supports and ties to secure the reinforcement properly shall be subject to the approval of the Engineer.

3-2-C-3-4 *Splicing*

Splices shall be avoided at points of maximum stress. They shall, where possible, be staggered, and shall be designed to develop the strength of the bar without exceeding the allowable unit bond stress. Unless otherwise shown on the plans, bars in the bottom of beams and girders, and in walls, columns, and haunches shall be lapped a minimum of twenty (20) diameters and bars near the top of beams and girders having more than thirty (30) centimeters of concrete under. The bars shall be lapped a minimum of thirty-five (35) diameters to make the splice. In no case shall bars be lapped less than thirty (30) centimeters.

3-2-C-3-5 *Couplers*

Couplers for reinforcement shall be either Standard Swaged Splices or Type II Alpha Couplers manufactured by CCL Systems Limited, Cabco House, Ewell Road, Surbiton, Surrey England, KT9 7AH, UK, or similar approved. Where bars of different diameters are to be joined a CCT. Reducer Sleeve or similar shall be used.

Couplers shall be suitable for the type and size of reinforcing bars and shall be capable of developing 125% of the characteristic strength of the smaller of the reinforcing bars being joined in both tension and compression. Couplers shall be installed in accordance with the manufacturer's recommendations. Square twisted reinforcing bars shall not be used with couplers.

3-2-C-3-6 *Reinforcing Bar Trusses*

Bar trusses shall be placed, supported and secured in proper position before beginning the placement of the concrete. Unless the bar trusses are so designed and fabricated with outstanding legs to be in contact with the forms they shall be supported on metal supports and spacers. If the weight of the trusses causes the supporting legs of trusses to indent into the forms, bar supports shall be used as auxiliary support for the truss legs.

3-2-C-3-7 *Mesh Reinforcement for Structures*

Mesh reinforcement shall be of the sizes and spacing of bars and sheets as shown on the plans. The sheets of mesh shall be lapped as indicated on the plans. The method of placing the mesh and securing it in proper position shall be approved by the Engineer.

3-2-D CONCRETE STRUCTURE CONSTRUCTION

3-2-D-1 DESCRIPTION

This Work shall consist of furnishing and placing Portland cement concrete for structures and incidental construction in accordance with the specifications and in conformity with the lines, grades and dimensions as shown on the plans or established by the Engineer.

3-2-D-2 CONSTRUCTION REQUIREMENTS

3-2-D-2-1 Falsework

Detailed plans for falsework and centering shall be prepared by the Contractor and submitted to the Engineer for approval. The plans must be approved by the Engineer before the Work is started.

Falsework and centering shall be designed and constructed to provide the necessary rigidity to support all loads placed upon it without appreciable settlement or deformation. Falsework columns shall be supported on wood or metal bases when it cannot be founded on rock, shale, or thick deposits of other compact material in their natural bed. Falsework shall not be supported on any part of the structure, except the footings, without the written permission of the Engineer. The number and spacing of falsework columns, the adequacy of sills, caps and stringers and the amount of bracing in the falsework framing shall be subject to approval of the Engineer.

Falsework and centering shall be designed and constructed to support the total anticipated loads with a deflection not to exceed two one-thousandths (0.002) of the falsework span. The Contractor shall submit calculations to support this requirement for all spans over three (3) meters and other spans if requested by the Engineer.

All timber shall be of sound wood, in good condition and free from defects that might impair its strength. If the vertical members are of insufficient length to cap at the desired elevation for the horizontal members, they shall preferably be capped and frames constructed to the proper elevation. Ends of the vertical members shall be cut square for full bearing to preclude the use of wedges. If vertical splices are necessary, the abutting members shall be of the same approximate size, the ends shall be cut square for full bearing and the splices shall be scabbed in a manner approved by the Engineer.

The Contractor shall provide means for accurately measuring settlement in falsework during placement of concrete and shall provide a competent observer to observe and correct the settlement.

In designing forms and centering, concrete shall be regarded as a liquid. In computing vertical loads, a weight of twenty-four hundred (2,400) kilograms per cubic meter shall be assumed, and not less than thirteen hundred and sixty (1360) kilograms per cubic meter shall be assumed in computing horizontal pressure.

The Engineer may refuse permission to proceed with other phases of the work if he deems the falsework unsafe or inadequate to support properly the loads to which it will be subjected.

The review or approval of falsework plans by the Engineer or permission to proceed with the work shall not relieve the Contractor of the responsibility for successful erection or satisfactory results.

3-2-D-2-2 Formwork

Forms shall be mortar tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations, including vibration. Forms shall be constructed and maintained so as to prevent the opening of joints due to shrinkage of the lumber. They shall be designed to permit easy removal without injury to the concrete. Form lining such as smooth, exterior grade plywood or other approved material shall be used for all formed surfaces. The Contractor shall submit samples, specifications and other pertinent information thereon to the Engineer and secure his prior written permission to use the form lining.

Form lining material shall not bulge, warp or blister, nor shall it stain the concrete. Form lining shall be used in the largest practicable panels to minimize joints. Small panels of the lining material shall not be permitted. The joints in the lining shall be tight and smoothly cut. Adjacent panels of form lining shall be so placed that the grain of the wood will be in the same general direction (all horizontal or all vertical). Thin metal form lining will not be permitted. Undressed lumber of uniform thickness may be used for backing for form lining. Wooden ply form, of adequate thickness, which is properly supported, may be used in lieu of the lined forms specified herein.

Forms shall be maintained after erection to eliminate warping and shrinkage. They shall be checked for dimensions and condition immediately prior to the placement of concrete. The Engineer may at any time require the revision or reconstruction of forms and may refuse permission to place concrete within the forms until they are satisfactorily constructed. If, at any period of the work during or after placing the concrete, the forms show signs of sagging or bulging, the concrete shall be removed to the extent directed by the Engineer, the forms brought to the proper position and new concrete placed. No allowance will be made to the Contractor for such extra work.

Metal forms may be used and are subject to the same requirements and approvals specified for wood forms. The specifications for wood forms with respect to design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse and oiling, also apply to metal forms. The metal used for forms shall be of such thickness that the forms will remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins of other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or do not line up properly shall not be used. Care shall be exercised to keep metal forms free from rust, grease or other foreign matter. Under such circumstances the continuance of use of the metal forms will depend upon satisfactory performance and their discontinuance may be required at any time by the Engineer. Steel panels with metal frames and wood or combination facing which leave permanent impressions or ridges will not be approved.

The inside of all forms shall be oiled with a light, clear, paraffin base oil that will not discolor or otherwise injure the surface of the concrete.

The oiling shall be done where possible after the completion of the forms and prior to placement of reinforcement.

Unless otherwise directed, the exterior side of all forms shall be painted with an approved, good quality high gloss white oil base enamel prior to placing concrete. When complete coverage is not obtained with one (1) coat, the Engineer will order additional coats as he deems necessary to obtain complete coverage. Forms shall be repainted when ordered by the Engineer.

Shrinkage cracks shall be closed by moistening the forms with water prior to concrete placement.

Forms that are to be reused shall be thoroughly cleaned and oiled and, if necessary, shall be reconditioned by revision or reconstruction. Unsatisfactory lumber will be condemned by the Engineer, and shall be removed from the site.

The width and thickness of the lumber, the size and spacing of studs and wales shall be determined with due regard to the nature of the work and shall be sufficient to ensure rigidity of the forms and to prevent distortion due to the pressure of the concrete.

Form bolts, rods or ties shall be made of steel. They shall be the type which permits the major part of the tie to remain permanently in the structure. They shall be held in place by devices attached to the wales capable of developing the strength of the ties. The Engineer may permit the use of wire ties on irregular sections and incidental construction if the concrete pressures are nominal and the form alignment is maintained by other means. The ties shall be removed on all exposed surfaces. The ties shall be removed to a depth of at least fifteen (15) millimeters below the concrete surface. Wire ties shall be cut back at least six (6) millimeters below the concrete surface. The cavities shall be filled with cement mortar composed of one (1) part by volume of cement and two (2) parts of sand and the surface left sound, smooth, even and uniform in color. Sufficient white Portland cement shall be mixed with the cement in the mortar, so when dry, the color will match the surrounding concrete. Form ties will not be permitted through forms for handrail. Pipe spreaders shall not be used unless they can be removed as the concrete is placed, as determined by the Engineer. Wood or metal spreaders shall be removed as the concrete is placed. The use of cofferdam braces or struts that extend through the forms for any concrete section will not be permitted except in unusual situations and then only with the approval of the Engineer.

Where the bottom of the forms is inaccessible, the lower form boards shall be left loose or other provisions made so that extraneous material may be removed from the forms immediately before placing the concrete.

Unless provided otherwise on the plans or directed by the Engineer, all exposed edges shall be beveled by using dressed, mill-cut, triangular molding, having twenty (20) millimeter sides.

All curved surfaces shall be formed with approved plywood or steel.

When instructed by the Engineer the Contractor shall submit formwork drawings and calculations to the Engineer in advance of the concreting.

Formwork shall be of such accuracy, strength and rigidity as to carry the weight and pressure from the concrete to be placed on or against it, together with all constructional wind or other loads likely to be imparted to it, without producing deformation of the finished concrete in excess of the specified tolerances.
Formwork shall be sufficiently tight without plugging to prevent loss of grout during the vibration of the concrete. When required by the Engineer joints between formwork facing boards shall be sealed with foam rubber sealing strips or other approved material.

Faces of formwork shall be clean, free from projecting nails adhering grout and other imperfections or defects. Formwork shall be treated with approved mould oil before positioning. The contractor shall prevent reinforcement or steelwork from being contaminated by the oil.
Formwork, which as a result of prolonged use or general deterioration or is otherwise in the opinion of the Engineer unsuitable shall not be used.
Through-bolts or ties will not be permitted in liquid-retaining structures. The Contractor shall use only such bolts or ties as are capable of being removed in whole or in part so that no part remaining embedded in the concrete shall be nearer the surface of the concrete than the specified thickness of cover to the reinforcement.

Beam soffits shall be erected with an upward camber of 5 mm for each 3 meters of span. Top

formwork shall be counterweighted or otherwise anchored against flotation.

Boxes for forming holes shall be constructed so as to be easily removable without damaging the concrete during removal. They shall be properly vented to permit the escape of entrapped air, and shall be capable of being sealed, subsequently to prevent the loss of grout.

On all external arises of the concrete 25 mm chamfers shall be formed.

Any openings provided in formwork for inspection and for cleaning-out shall be formed so that they can conveniently close before the placing of concrete.

All props shall be supported on adequate sole plates and shall not bear directly on or against concrete. They shall be capable of being released gently and without shock to the formwork. No appliance for supporting the formwork shall be built into the permanent structure without the Engineer's prior approval. Props for upper-level support shall be placed directly over those at lower levels. Props shall only bear upon work sufficiently mature to carry the load.

Formwork shall be such as to allow for its removal without damaging the concrete and in the case of suspended floors for the removal of the beam sides and slab soffits without disturbing the beam-bottom boards and their props.

Before concreting, the areas which are intended to receive the concrete shall be cleaned by jetting with compressed air and all water and extraneous material removed.

Where timber is used for formwork, it shall be properly cured free from warp straight, clean and free from loose knots.

Where metal forms are used for formwork, they shall be of the type strengthened by intermediate ribs or cross bracing.

Moving formwork man be used if the Engineer sees it appropriate.

3-2-D-2-2-1Sawn Formwork

Sawn formwork shall be properly designed and constructed of closely-jointed Sawn boards sheet metal or other approved material. It shall produce a standard of finish free from substantial voids, honey-combing or other large blemishes. There shall be no loss of grout.

3-2-D-2-2-2Wrought Formwork

All exposed concrete shall be formed by wrought formwork.

Wrought formwork shall produce a high standard of finish with a hard smooth surface with true clean arises. Only minor surface blemishes shall be permitted. The face in contact with the concrete shall consist of framed plywood or metal panels or other approved material. Joints between boards and/or panels shall be arranged in a uniform pattern.

3-2-D-2-3 Tolerances

Unless otherwise indicated on the Drawings, the tolerances of the finished concrete with respect to the dimensions shown on the Drawings shall not exceed the limits set out in the following Table. Formwork shall be constructed to ensure completed work within the following tolerance limits:

Departure from established alignment	0.5 cm
Departure from established grade	0.5 cm
Variations from plumb or specified batter in lines 0.5 cm in and surfaces of columns, piers and walls	0.5 cm in meters if
Variations from level or indicated grade in slabs, beams, etc.	0.5 cm in if backfilled 3
	0.5 cm in meters, if exposed 3
Variation in cross-sectional dimensions of columns piers, slabs, walls, beams	3 meters, if exposed 3,
	-0.5 cm +
Variations in slab thickness	-0.5 cm + 0.5 cm
Footings: Plan Dimensions	-0.5 cm + 0.5 cm
Eccentricity Reduction in thickness	2 percent of footing width, not exceeding 5 cm 2 percent of specified thickness

3-2-D-2-4 Removal of Forms and Falsework

To facilitate finishing, forms on handrails, ornamental work and other vertical surfaces that require a rubbed finish shall be removed as soon as the concrete has hardened sufficiently that it will not be injured as determined by the Engineer. In determining the time for the removal of forms, consideration shall be given to the location and character of the structure, weather and other conditions influencing the setting of the concrete.

If removal of forms or falsework is not controlled by beams or cylinders cured with and under the same conditions as the structure, the following periods, exclusive of periods when the temperature is less than four (4) degrees C, for releasing of forms and supports shall be used as a minimum:

- Arch Center 14 days
- Centering Under Beams 14 days
- Supports Under Flat Slabs 14 days
- Floor Slabs 14 days
- Vertical Wall Surfaces 24 hours
- Columns 24 hours
- Sides of Beams 24 hours
- Top Slabs R.C., Box Culverts 14 days

If high early strength cement is used, the time limits may be decreased as determined by the Engineer.

When form and falsework removal is controlled by beams or cylinders cured with, and under the same conditions as the structure, the release of falsework in load or movement carrying members shall not occur until the concrete has reached its specified strength. In no case shall release be permitted in less than seven (7) days.

Methods of form removal likely to cause overstressing of the concrete shall not be used. In general, the forms shall be removed from the bottom upwards. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In general, arch centering shall be struck and the arch made self-supporting before the railing or coping is placed. For filled spandrel arches, such portions of the spandrel walls shall be left for construction subsequent to the striking of centers, as may be necessary to avoid jamming of the expansion joints. In arch structures of two or more spans, the sequence of striking centers shall be as specified or approved.

Immediately after the removal of the forms, all fins caused by form joints and other projections shall be removed and all pockets cleaned and filled with a cement mortar composed of one (1) part by volume of Portland cement and two (2) parts sand. Sufficient white Portland cement shall be mixed with the cement in the mortar, so that when dry, the color will match the surrounding concrete. Patches shall be moistened prior to mortaring to obtain good bond with the concrete. When directed by the Engineer, the Contractor shall at his own expense, substitute an approved epoxy grout for the Portland cement mortar or provide an epoxy bonding agent to be used in conjunction with the Portland cement mortar. If, in the judgment of the Engineer, rock pockets are of such extent or character as to materially affect the strength of the structure or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of that portion of the structure affected. The resulting surfaces shall be true and uniform. Portions of the structure which cannot be finished or properly repaired to the satisfaction of the Engineer shall be removed.

3-2-D-2-5 Mixing and Transporting

3-2-D-2-5-1 Mixing

Concrete shall be mixed in quantities required for immediate use. Concrete shall not be used which has developed initial set or is not in place one-half (1/2) hour after the water has been added for non-agitated concrete or if agitated, the concrete must be in place one and one-half (1-1/2) hours after the water has been added. Retempering concrete by adding water or by other means will not be permitted. Concrete that is not within the specified slump limits at the time of placement shall not be used and shall be disposed of as directed by the Engineer.

The Concrete may be mixed at the site of the work, in a central-mix plant, or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of Section 3.3 "Ready-Mixed Concrete and Central- Mixed Concrete".

When mixed at the site of the Work or in a central-mixing plant, the mixing time shall not be less than fifty (50) seconds nor more than ninety (90) seconds. Four (4) seconds shall be added to the specified mixing time if timing starts the instant the skip reaches its maximum raised position. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

The mixer shall be operated at a drum speed as shown on the manufacturer's nameplate on the approved mixer. Any concrete which, in the opinion of the Engineer, is mixed more or less than the specified time shall be discarded and disposed of by the Contractor at his expense. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic meters, as shown on the manufacturer's standard rating plate on the mixer; except that an overload up to ten (10) percent above the mixer's nominal capacity may be permitted when approved by the

Engineer, provided concrete test data for strength, segregation and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first fifteen (15) seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

3-2-D-2-5-2Central-Mixing

Plants for concrete shall comply with the following requirements, in addition to those set forth above:

3-2-D-2-5-2-1 Cement

Means provided for storing cement shall be as approved by the Engineer. The Contractor shall clean all conveyors, bins and hoppers of unapproved cement before starting to manufacture concrete for the work.

3-2-D-2-5-2-2 Aggregate

Coarse and fine aggregate to be used in concrete shall be kept in stockpiles and bins apart from aggregate used in other work. Aggregates shall come from a source approved by the Engineer. The Contractor shall clean all conveyors, bins and hoppers of unapproved aggregate before starting to manufacture concrete for the work.

3-2-D-2-5-2-3 Consistency

The Contractor shall be responsible for producing a concrete that will be of the proper consistency when delivered to the job site.

3-2-D-2-5-2-4 Hauling

Mixed concrete from the central-mixing plant shall be transported in truck mixers, truck agitators, non-agitating trucks having special bodies or other approved containers.

3-2-D-2-5-2-5 Time of Haul

The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed thirty (30) minutes when the concrete is hauled in non-agitating trucks, nor more than ninety (90) minutes when hauled in truck mixers or truck agitators.

3-2-D-2-5-2-6 Delivery

The Contractor when supplying concrete from a central plant shall have sufficient plant capacity and transporting equipment to ensure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The method of delivery and handling the concrete shall be such as will facilitate placing with a minimum of re-handling and without damage to the structure or the concrete. Methods of delivery and handling for each site shall be approved by the

Engineer. The Engineer may delay or suspend the mixing and placing of concrete at any site for which he considers the Contractor's delivery equipment inadequate, until such time as the Contractor provides additional approved delivery equipment.

3-2-D-2-5-3 Transporting

Concrete shall be transported to the place of final deposit by approved means.

Barrows, spades and other equipment used in the process of transporting concrete shall be thoroughly cleaned before each day's work or after a long interruption and they shall be free from hardened concrete.

Concrete shall be transported as soon as possible after mixing, by methods which will prevent the segregation, loss or contamination of the ingredients.

Bridging for traffic over reinforcement shall be provided so that the reinforcement is not distorted, damaged or displaced.

Where approval is obtained for concrete to be conveyed by chutes. These shall have a slope (not exceeding 1 vertical to ' horizontal) such as to ensure a continuous flow of concrete. Additional water shall not be introduced to assist the flow. If deposition is to be intermittent the chute shall be arranged to discharge into a storage hopper. In no case a clear fall of more than 1 m be permitted at the discharge end of the chute.

Where approval is obtained for pumping the concrete, the pump manufacturer's recommendations as approved by the Engineer shall be followed. The pumps used shall be of adequate capacity and power to ensure delivery of a continuous supply.

Wherever transport of concrete is interrupted for any period of over half an hour the chutes, pumps, pipes and any other means of distribution shall be thoroughly flushed out and cleaned.

These shall also be flushed out immediately prior to resumption of concreting and shall be kept free from hardened concrete. All washing water used shall be discharged outside the formwork and clear of any freshly placed concrete.

3-2-D-2-6 Handling, Placing, Concrete and Compacting

Concrete shall not be placed until forms and reinforcing steel have been checked and approved by the Engineer. The forms shall be clean and free of all debris before concrete is placed. The method and sequence of placing concrete shall be approved by the Engineer.

The external surface of all concrete shall be thoroughly worked during the placing by means of tools of an approved type. The working shall be such as to force all coarse aggregate from the surface and to bring mortar against the forms to produce a smooth finish, substantially free from water and air pockets, or honeycomb.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. Concrete shall not be deposited in large quantities at any point in the forms and then run or worked along the forms, thus causing segregation of the materials.

The concrete shall be deposited in the forms in horizontal layers and the work shall be carried on rapidly and continuously between predetermined planes agreed upon by the Contractor and the Engineer. Keyways shall be formed between layers.

Where steep slopes are required for placing concrete with chutes, the chutes shall be equipped with baffle boards or be in short lengths that reverse the direction of movement. Chutes and the use of chutes must be approved by the Engineer.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. The water used for flushing shall be discharged clear of the concrete already in place.

Concrete shall not be dropped in the forms a distance of more than one and one-half (1-1/2) meters, unless confined by approved closed chutes or pipes and care shall be taken to fill each part of the form by depositing the concrete as near final position as possible. The coarse aggregate shall be worked back from the forms and worked around the reinforcement without displacing the bars. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement.

Unless otherwise directed, the concrete shall be compacted with suitable mechanical vibrators operating within the concrete. When required, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction.

Vibrators shall be of an approved type and design.

Vibrators shall be so manipulated as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. Vibrators shall not be used as a means to cause concrete to flow or run into position in lieu of placing. The vibration at any point shall be of sufficient duration to accomplish compaction, but shall not be prolonged to the point where segregation occurs.

Concrete shall be deposited in water only with the permission of the Engineer and under his supervision. The minimum cement factor of the class of concrete being deposited in water shall be increased ten (10) percent without further compensation and the slump shall be approximately fifteen (15) centimeters. When depositing in water is allowed, the concrete shall be carefully placed in the space in which it is to remain in a compact mass, by means of a tremie, bottom-dumping bucket, or other approved method that does not permit the concrete to fall through the water without adequate protection. The concrete shall not be disturbed after being deposited. No concrete shall be placed in running water, and forms which are not reasonably watertight, shall not be used for holding concrete deposited under water.

Pumping will not be permitted from the inside of the foundation forms while concrete is being placed. If necessary to prevent flooding, a seal of concrete shall be placed through a closed chute or tremie and allowed to set.

When casings are used in drilled shafts, the casing shall be smooth and well-oiled and shall extend sufficiently above the grade of the finish shaft to provide excess concrete to be placed for the anticipated slump due to the casing removal. When the casing is to be pulled, the concrete placed in the casing shall have such a slump and be of such workability that a minimum amount of vibrating will be required.

No concrete work shall be stopped or temporarily discontinued within forty-five (45) centimeters of the top of any finished surface, unless such work is finished with a coping having a thickness less than forty-five (45) centimeters in which case the joint shall be made at the under edge of the coping.

Concrete in simple slab spans shall be placed in one (1) continuous operation for each span, unless otherwise indicated on the plans or approved by the Engineer. For continuous slab spans, concrete shall be placed in the sequence shown on the plans, except that with the approval of the Engineer, consecutive placement may be combined in a single placing operation to cover from one end of a unit to the other.

Concrete in simple or continuous T-beam spans may be placed in one (1) continuous operation, or when shown on the plans or approved by the Engineer, may be placed in two (2) separate operations; first, to the top of the girder stems, and second, to completion.

The concrete in arch rings shall be placed in such a manner as to load the centering uniformly. Arch rings, preferably, shall be cast in transverse sections of such size that each section can be cast in a continuous operation. The arrangement of the sections and the sequence of placing shall be as approved by the Engineer, and shall be such as to avoid the creation of initial stress in the reinforcement. The sections shall be bonded together by suitable keys or dowels. When permitted by the Engineer, arch rings may be cast in a single continuous operation.

Before concrete floors are placed on steel spans, the centering under the spans shall be released and the spans swung free on their supports unless otherwise indicated on the plans. The operation of placing the concrete in any floor slab shall be continuous until complete, except where joints are provided on the plans or authorized by the Engineer. When a special sequence or method of concrete placing operations is indicated on the plans, or designated by the Engineer, this sequence or method shall be followed.

The method used for transporting concrete batches, materials, or equipment over previously placed floor slabs or floor units or over units of structures of continuous design types shall be subject to approval by the Engineer. Trucks, heavy equipment and heavy concentration of materials will be prohibited on floor slabs until the concrete has attained its design strength.

Where concrete is to be placed in lifts greater than 2.5 m high it shall be placed by suitable tremie pipes. Shutters for lift heights greater than 3 m shall incorporate windows in suitable places to allow placing and vibration.

3-2-D-2-7 Hot Weather Concreting (for temperatures above 20°C)

Concreting shall not be permitted if its temperature at placing is in excess of 38°C. In order to maintain the temperature of the concrete below this value the following precautions shall be taken wholly or in part as instructed by the Engineer:

All aggregate stockpiles, water lines and tanks as well as the mixer shall be protected from the direct rays of the sun.

Coarse aggregate shall be cooled by constant watering where possible.

Mixing water shall be cooled by the addition of ice to the storage tanks where necessary. Rapid-hardening cement shall not be used.

Where the above precautions are inadequate concreting shall be carried out during the cooler parts of the day or during the night as may be directed by the Engineer.

When the air temperature is above 20°C loss of mixing water by evaporation shall be considered in arriving at the amount of water to be added to the mix. To maintain the water/cement ratio within permissible limits an approved water-reducing agent shall be included in the mix.

The maximum water/cement ratios may be increased with the Engineer's permission by 0.05 (or 2.5 litres/50 kg of cement) during mixing, but on no account shall water be added to concrete once it has left the mixer.

In order to reduce premature drying of the concrete during transporting and placing, all chutes, formwork and reinforcement shall be cooled by watering when possible, or shall otherwise be protected from the direct rays of the sun.

As soon as possible after concreting, the formwork shall be stripped and the surface of the concrete shall be treated.

Where drying winds are encountered, wind shields shall be positioned as necessary to protect exposed surfaces of the curing concrete.